RIGOROUS COMPILATION OF THE NORTHERN INTERNATIONAL REFERENCE STARS

BY

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The tabular method of determining the systematic differences between two star catalogues is discussed. It is noted that the tabular method is subjective in nature and that the estimation of the model parameters does not use all available model constraints. Furthermore, these estimates are not least squares estimates nor are they unbiased.

The simultaneous estimation of both target parameters and model parameters is applied to the compilation of a complete star catalogue. By simultaneously using all available constraints on all available data, more precise estimates for the target parameters are obtained. The input material

of the Northern International Reference Stars (NIRS) is used and the resulting catalogue is compared to the NIRS catalogue compiled by Corbin using standard techniques. It is shown that the new estimates of the star parameters have smaller formal errors than estimates derived from the same material but using conventional procedures. Both versions of the NIRS are used to predict the star positions of the later observed Perth 70: A Catalogue of Positions of 24900 Stars and these predicted positions are compared to the actual observed positions. It is found that a simultaneous reduction results in a slight but significant improvement in the predicted positions.

CHAPTER I
INTRODUCTION

The Establishment of an Inertial Reference Frame

One of the goals of kinematic astronomy is the empirical establishment of a frame of reference in which Newton's first and third postulates of motion are valid. To those involved in this endeavor, two important facts become readily apparent. First, in all areas of science which involve dynamics, such as lunar and planetary theory, galactic dynamics, astronautics, among others, the determination of an inertial reference frame to some required accuracy is essential. Second, the complexities of the determination of this inertial reference frame are often completely ignored. The fact that the determination of an inertial reference frame has been taken for granted is a tribute to all the astronomers who have, over the centuries, performed this indispensable service for their fellow scientists. This work, however, is never finished. As science progresses so does the precision of measurements increase which in turn requires an increased accuracy of the standard.

Due to the rotational and revolutionary motion of the Earth, it has long been realized that stars can be used to

define, in practice, an inertial reference frame. The sighting of stars has been used by sailors for centuries to determine their latitude and longitude on the rotating Earth and, more recently, star positions are being used to navigate the Voyager spacecraft past Jupiter, Saturn, Uranus and Neptune. In kinematic astronomy, the most frequently used coordinates are not cartesian coordinates but spherical polar coordinates. This is so because the position of an object, which is defined by two angular coordinates (e.g. right ascension and declination), can be accurately determined to a fraction of a microradian while the radial distance is known only to one or two significant figures if at all. The position of a star, defined by these two angular coordinates, fixes its place on the imaginary "celestial sphere." Conversely, any two non-diametrically opposed stars whose position and proper motion estimates are given in a star catalogue, uniquely define the coordinate system of that catalogue and provide the basis for the establishment of an inertial reference frame.

A coordinate system (or simply a "system") in connection with a star catalogue, is not necessarily inertial; rather, estimates for the parameters needed to transform the system to an inertial reference frame are assumed known. If estimates for the distances and radial velocities of some of the stars in a catalogue are known, this information can be combined with the positions and proper motions in order to

estimate Oort's constants of galactic shear and galactic rotation as well as the solar motion. Thus the kinematics of our Milky Way galaxy are described and an inertial reference frame is established.

A fundamental star catalogue contains the positions and proper motions of at least several hundred stars and therefore overdetermines, in a sense, the system which is defined. In light of this, certain concepts related to a catalogue's system need further clarification. Eichhorn (1982) has given concise definitions to these concepts. First, it must be borne in mind that the "star positions" which are listed in a star catalogue are only estimates. If the errors in these estimates are purely random, the system is defined by any randomly selected subset of star positions to the precision of the individual positions. However, if there are systematic errors of star positions dependent on which part of the sky is under consideration, or other parameters charcterizing the stars such as brightness or color, the system will be dependent on which subset of star positions is used to define it.

It is often found that there exist differences in the systems of catalogues which are functions of the sections of the sky under consideration. In order to combine independent star catalogues into a compilation catalogue, these systematic differences must be modeled and the parameters of these models must be estimated. In this way

it is possible to correct the systematic trends of each independent catalogue in order to bring them all onto a common "system."

This research investigates the techniques used to model the systematic differences between the systems of star catalogues, as well as the procedures used to estimate the parameters of these models.

The International Reference Star Program

The International Reference Star program (IRS) is a multinational effort whose execution has required more than a quarter of a century. Its aim is to provide more than 40,000 accurate and precise star positions and proper motions over the entire sky (Scott 1967, Scott and Schombert 1970, Smith 1979, Corbin 1985). Transit circle catalogues from around the globe are being compiled into compilation catalogues with a density of about one star per square degree. With these catalogues, the fundamental system of the Fourth Fundamental Catalogue (FK4) (Fricke and Kopff 1963) can be extended to fainter magnitudes such that over 300,000 star positions of all stars to the 9th magnitude can be tightly related to the fundamental system.

The northern half of this program (NIRS) can be traced back to the Catalog of Reference Stars for the Dritter Katalog der Astronomischen Gesellschaft (AGK3R). One of the aims of the NIRS was to provide proper motions for the AGK3R

stars. Unavoidably (and fortunately), this also led to improved positions. The NIRS was compiled from observed positions in 64 independent meridian catalogues whose mean epochs date back as far as 1889.

The catalogue of Northern International Reference Stars (NIRS) (Corbin 1974, 1977, 1982) contains positions and proper motions of 20194 stars in the declination zone -5 to +90 degrees of apparent visual magnitude 6.5 to 9.5. NIRS was compiled from independent catalogues (ICs) which only contain star positions measured at a given epoch. Corbin constructed this catalogue in a two-step process. First, the systematic differences between the star positions in each of the ICs and the reference star positions of the FK4, which is the target system, were calculated. Systematic corrections were computed from these differences and applied to all star positions in the ICs in order to bring them onto the system of the FK4. Second, from the thus corrected and weighted IC positions, a complete catalogue of appropriate stars was constructed.

It must be noted that Corbin used no intercomparisons of ICs to calculate systematic corrections. That is, when estimating the parameters of the models of systematic differences, the only constraints which were used were those which minimized the systematic differences in star positions between ICs and and the reference catalogue. The constraints which require that the systematic differences in

star positions between independent catalogues also be minimized were not used. In light of this fact, it is apparent that better estimates of the parameters are available with procedures which use all available constraints on all available data (cf. Eichhorn and Cole 1985).

CHAPTER II
CATALOGUE COMPILATION

The Estimation of Systematic Differences

The difference between the position estimate of a star in two catalogues originates from the random errors of the observations from which the positions in each of the catalogues were computed and the inconsistencies of the systems defined by the star positions of the catalogues. In computing corrections to bring a catalogue onto a system, one seeks to minimize the differences between the defining systems without changing the accidental errors in the individual position estimates. In correcting for systematic errors, the usual procedure is to model the source of the error, guided by the geometry and, when indicated, the physics of the actual measuring situation. In the case of star catalogues this technique is impossible, in practice, because there are too many small sources of systematic errors which occur at different stages of the data reduction process. Often, their presence is either unsuspected or reasonably accurate models for them are difficult to establish. Systematic errors can, for example, be introduced by an inaccurate refraction correction. Likewise it is difficult to determine the optical characteristics of

an instrument which was destroyed in the Second World War. It is thus easier to lump errors from all sources together and model them by some empirical interpolary function.

We see that the systems defined by star catalogues, since they are only estimates, can only approximate the unobtainable ideal target inertial reference frames. Therefore the actual, true systematic errors of a catalogue can never be rigorously and unambiguously found or even defined. What can be defined and estimated are model dependent systematic differences between the systems defined by any two catalogues. Once systematic differences[1] are found, they can be applied to the positions in one catalogue as systematic corrections in order to bring the two catalogues ideally onto the same system. Regardless of the functional form of the model for the systematic differences between two catalogues, when two or more catalogues are being combined, there are, in principle, two distinct methods to compute these systematic differences.

The traditional methods utilize the comparisons of the positions of only those stars common to each IC and the reference system (the FK4 in this case) for the derivation of the systematic corrections for that IC. Systematic corrections are then determined from these individual comparisons only. Since the star density in a typical IC is

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[1] For the purposes of this research, the term "systematic error" will be used to denote the systematic difference between an IC and the FK4.

much higher than that of the reference system, systematic properties of an IC have often been estimated from as few as 5 percent of the star positions in that IC.

Traditionally, position differences averaged over blocks of the sky and smoothed with adjacent blocks are applied as systematic corrections. It appears that several problems arise with this traditional tabular method. First, the smoothing coefficients are chosen on a subjective basis. Second, not all of the available model constraints are used in estimating the model parameters. This means that the procedure which estimates the model parameters does not constrain these model parameters to minimize some measure of the systematic differences between all ICs but rather the model parameters are constrained only to minimize a measure of the systematic differences between each IC and the fundamental system. Finally when estimating the parameters in the tabular model, the estimates obtained are not least squares estimates but estimates used only because, from a computational standpoint, they are easily accessible. While this results in an acceptable star catalogue, the process involves a high level of subjective judgement which is undesirable and uncommon in most scientific investigations. More sophisticated models (Bien et al. 1978) define as the measure for the systematic differences the sum of orthogonal functions (Brosche 1966, Schwan 1977, 1985) and then use individual positions in a least squares algorithm to determine the parameters of these functions.

On the other hand, a simultaneous reduction sets up all condition equations in closed form and solves for target parameters (star positions and proper motions) and model parameters (systematic errors) at the same time. The advantage here is that all available constraints on all available data are used to estimate both sets of parameters and that all estimates are least squares estimates.

Critique and Analysis of the Tabular Procedure

In spite of the fact that the tabular method has been producing very good results for over a century, it is poorly defined and the underlying assumptions have never been explictly stated. That is, the tabular method, with smoothing included, has never been defined in terms of a model, but only as a "cookbook recipe" as it were. Without the benefit of a model and specifically, without the benefit of the assumptions concerning the joint probability distribution of the random quantities, it is impossible to assign a meaning to terms such as the bias and variance of the estimated parameters. One cannot speak of the bias of an estimate unless one knows the expected value of that estimate. One cannot know the expected value of an estimate unless one knows the probability distribution of that estimate. One cannot know the probability distribution of an estimate unless there exists a model which specifies the dependence of the estimate on the random quantities.

In the simplest case of a tabular method without smoothing, the systematic error of an IC is considered a fixed constant in each subjectively delineated domain. The model for the observed error of the position of star μ in domain ν, $\Delta_{\mu\nu}$, is

$$\Delta_{\mu\nu}=\rho_\nu+\varepsilon_{\mu\nu}, \quad \mu=1,2\ldots n_\nu, \quad \nu=1,2\ldots m \tag{1}$$

where p_ν is the fixed but unknown systematic error in domain number ν and $\varepsilon_{\mu\nu}$ is an independent and normally distributed random error with mean zero and constant variance σ^2 for all $\mu\nu$. Under these assumptions one invokes the principle of least squares and minimizes the sum of all $\varepsilon^2_{\mu\nu}$. In this way one obtains estimates $\hat{p}_\nu$ for p_ν as the mean of all $\Delta_{\mu\nu}$:

$$\hat{\rho}_\nu= \sum_{i=1}^{n_\nu} \frac{\Delta_{i\nu}}{n_\nu} \tag{2}$$

n_ν, of course, being the number of differences formed in the νth domain. An unbiased estimate, s^2_ν, for σ^2 is

$$s^2_\nu = \frac{\sum_{i=1}^{n_\nu}\Delta^2_{i\nu}-n_\nu\hat{p}^2_\nu}{n_\nu-1} . \tag{3}$$

So far this is statistically sound, because the estimates of the systematic errors are uncorrelated under the given assumptions. The estimate of their (diagonal) covariance matrix is

$$S^2 = \mathrm{diag}(S^2_1/n_1,\ S^2_2/n_2\ldots S^2_m/n_m) \tag{4}$$

where m is the number of domains involved in the process.

Unfortunately, the model in (1) proves inadequate. Experience has shown that the domains cannot at the same time be chosen small enough to model with sufficient accuracy the structure of the systematic differences and yet large enough not to mask the random errors of the observations. The accepted solution to this problem calls for choosing smaller domains and then "smoothing" each estimate, $\hat{p}_\nu$, with its immediate neighbors. It is during this process of smoothing that the reference to a model and its underlying assumptions is lost. However, this procedure will still produce some kind of a numerical result.

If smoothing is involved, one can only infer a model working backwards from the "recipe." It is implied that the model for the observed error of the position of star μ in domain ν is

$$\Delta_{\mu\nu} = \sum_{j=1}^{m} a_j p_j + \varepsilon_{\mu\nu}, \quad \sum_{j=1}^{m} a_j = 1 \tag{5}$$

where the p_js are again fixed constants, $\varepsilon_{\mu\nu}$ is again an independent and normally distributed random error and the a_js are subjectively chosen smoothing constants with smoothing occurring over domains in the neighborhood of ν. The method of least squares would yield the estimates, $\hat{p}_\nu$, by minimizing the quantity

$$\sum_{j=1}^{m} \sum_{i=1}^{n_j} \varepsilon_{ij}^2 = \sum_{j=1}^{m} \sum_{i=1}^{n_j} (\Delta_{ij} - \sum_{k=1}^{m} a_k p_k)^2. \tag{6}$$

In practice this is, however, not done; rather the $\hat{p}_\nu$s are obtained from equation (2)!

The assumptions of the model function and those of the procedure for estimation of the model parameters thus contradict each other. The model function (5) is predicated on the assumption that the p_νs are correlated, thus giving justification for the smoothing process, while the estimation of the model parameters from (2) is based on the assumption that the p_νs are independent.

Assuming the model (5), the estimates of the model parameters from (2) are therefore biased. The bias of an estimate $\hat{p}_\nu$ is the expected value of the estimate minus the true value of the parameter or

$$\sum_{j=1}^{m} a_j p_j - p_\nu \tag{7}$$

which is, in general, not equal to zero. One result of these estimates being biased is that once systematic differences are calculated, smoothed and applied as systematic corrections, if systematic differences were again calculated and smoothed using the same coefficients, the resulting corrections would not be zero. That is, after a catalogue is "corrected" using these biased estimates, if systematic corrections were again calculated in the same manner, the second set of corrections would be different from zero.

As a demonstration of this phenomenon, the Catalogue Méridien de 2024 Étoiles Repères de la Zone +11° a +18° (Bord 50) was corrected to the system of the FK4 using the tabular method with smoothing as described in chapter 3. The upper part of table 1 lists the corrections to the declinations of the Bord 50 in hundredths of arcseconds at gridpoints separated by one hour in right ascension and five degrees in declination. The individual positions of the Bord 50 were corrected with this table using two-way linear interpolation. The lower part of table 1 lists the corrections to the declinations of the Bord 50 in hundredths of arcseconds, computed with the same smoothed tabular method, using the "corrected" Bord 50 and again only the FK4 as a reference system. Although the second set of corrections is smaller than the first, the second set would be identically zero if the first set had not been biased.

The concept of a covariance matrix of the model parameters is very problematical in this contradictory environment. Without an estimate of this covariance matrix, the tabular method cannot be objectively compared to other methods. Only a subjective comparison of the "goodness" of results is available with the tabular method.

When one discuses and-inevitably-criticizes these methods, one must remember that they were established at a time when most calculations had to be performed with logarithm tables and only later with mechanical desk

TABLE 1
Succesive Corrections Computed with Biased Estimates

Corrections computed for the Bord 50 declinations:

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	2	7	10	13	13	9	12	16	18	17	13	9	8	6	5	2	1	1	-1	0	-1	-3	-4	-1
25	6	8	12	13	17	15	17	19	18	17	13	9	8	7	7	7	5	5	4	4	3	2	2	4
20	4	2	3	5	7	9	12	15	14	12	10	7	6	5	4	5	3	0	-2	-4	-3	0	1	3
15	-1	-5	-5	-3	-2	2	2	3	4	6	8	5	2	1	2	4	2	-2	-6	-8	-6	-5	-1	-2
10	-4	-7	-7	-7	-5	-3	-3	-5	-2	-1	1	0	-2	-1	0	1	-1	-4	-5	-5	-3	-2	-1	-3
5	-8	-10	-12	-13	-11	-9	-8	-10	-9	-10	-9	-8	-7	-6	-5	-5	-5	-5	-7	-7	-6	-3	-3	-4
0	-13	-14	-17	-19	-18	-17	-17	-15	-12	-12	-11	-10	-10	-11	-10	-11	-8	-8	-10	-12	-13	-8	-8	-8

Corrections computed for "corrected" Bord 50 declinations:

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	-2	0	1	2	0	-4	-3	0	1	1	0	0	0	0	-1	-2	-3	-2	-2	-1	-1	-3	-4	-3
25	1	2	3	2	4	2	2	3	2	2	0	-1	0	1	2	2	1	2	2	3	2	1	1	1
20	1	-1	-2	-1	0	1	2	4	2	0	0	-1	0	0	0	1	0	-1	-1	-1	-1	0	0	1
15	0	-2	-3	-2	-3	0	-1	-1	-1	1	3	1	-1	-1	0	1	1	-1	-2	-3	-2	-1	0	-1
10	1	0	0	1	1	2	1	-2	0	1	3	2	0	1	2	2	1	0	0	0	1	1	2	0
5	0	0	-2	-2	0	0	0	-2	-1	-2	-1	-1	-1	0	0	0	0	0	-1	-1	0	1	1	1
0	-3	-2	-4	-4	-3	-4	-4	-4	-1	-2	-2	-2	-2	-3	-3	-4	-1	0	-2	-4	-5	-1	-1	0

calculators. Often, the necessary computing effort was the deciding factor as to whether a project was feasible or not. With the advent of computers, it is now practical to undertake enormous data reduction problems which require the simultaneous estimation of tens of thousands of parameters without taking any computational shortcuts which degrade, even if ever so slightly, the results. It is now possible to reduce the avoidable subjectiveness of a scientific investigation so that its results can be judged on an objective basis.

It must also be noted that there are many vital interests in the results of astrometrists. For example, the time standard provided by astrometrists is relied on to syncronize global satellite communications and calibrate radio navigation. Thus astrometrists must be absolutely certain of their results. With this in mind one might argue that caution should be exercised in the acceptance of any new procedure. While this is a legitimate concern, because of the importance of this work, catalogue astrometry does deserve the full analytical treatment which is now available. There is no excuse for not using a rigorous reduction in the compilation of a complete star catalogue.

Description of Simultaneous Reduction

As mentioned above in regard to estimating the systematic errors of a catalogue, there are two distinct methods to

compute these estimates. In the tabular procedure, one estimates the systematic characteristics of a catalogue and adjusts the catalogue in order to correct these systematic trends. Once all the catalogues are on the same system, estimates for the individual positions and proper motions are calculated.

In a simultaneous reduction, systematic corrections (model parameters) and positions and proper motions (target parameters) are estimated simultaneously. In this way not only are the systematic differences between the independent source catalogues and the fundamental system of the FK4 minimized, but the systematic differences between all catalogues are minimized as well. The incorporation of all available information for the derivation of systematic corrections yields a result more precise and accurate than that achieved by traditional methods. The idea that all parameters, used in the construction of a complete catalogue, should be solved for in a single adjustment was first suggested by Eichhorn (1974) and later described by him in more detail (Eichhorn 1980).

Within the framework of this research I have employed this principle to estimate simultaneously systematic corrections for all ICs used to construct the NIRS on the basis of exactly the same model and from exactly the same raw material as those used by Corbin. Corbin's model computes differences on a grid at each hour of right

ascension and each five degrees of declination and then uses two-way linear interpolation to compute corrections to individual IC positions. The smoothing coefficients and the weights of the individual catalogues were also the same as in the model used by Corbin. The only difference between the the reductions was the method of computing systematic differences.

Consider the linear matrix equation

$$\underline{Y} = \underline{X\beta} + \underline{ZP} + \underline{\varepsilon} \tag{8}$$

where $\underline{Y}$ is a vector of observations, $\underline{\beta}$ and $\underline{P}$ are the target and model parameters respectively, $\underline{X}$ and $\underline{Z}$ are their respective coefficient matricies and $\underline{\varepsilon}$ is a vector of errors with covariance matrix $\underline{\Sigma}$. This equation could be alternately and more compactly written

$$\underline{Y} = [\underline{XZ}][\frac{\beta}{\underline{P}}] + \underline{\varepsilon} = \underline{A\phi} + \underline{\varepsilon}. \tag{9}$$

A simultaneous reduction estimating both model and target parameters would yield least squares estimates

$$[\frac{\hat{\beta}}{\underline{\hat{P}}}] = \underline{\hat{\phi}} = [\underline{A}^T\underline{\Sigma A}]^{-1}\underline{A}^T\underline{\Sigma Y}. \tag{10}$$

If model parameters are estimated first and target parameters second, the least squares estimates are

$$\underline{\hat{P}} = (\underline{Z}^T\underline{\Sigma Z})^{-1}\underline{Z}^T\underline{\Sigma}(\underline{Y}-\underline{X\beta}') \qquad \text{and} \tag{11}$$

$$\underline{\hat{\beta}} = (\underline{X}^T\underline{\Sigma X})^{-1}\underline{X}^T\underline{\Sigma}(\underline{Y}-\underline{Z\hat{P}})$$

where $\underline{\beta}'$ are preliminary estimates for $\underline{\beta}$. In trying to perform a simultaneous reduction of the NIRS using the same model as Corbin, I had to decide how to handle two problems. First there was the computational difficulty of inverting the $\underline{A}^T\underline{\Sigma}\,\underline{A}$ matrix in (10). Since I have approximately 40,000 star parameters and 20,000 model parameters, this means that a 60,000 by 60,000 element matrix must be inverted. Although there exist procedures (cf. Lawson and Hanson 1974) which render a solution without the direct inversion of this matrix, a problem of this size requires more virtual address space than the Fortran application, which was at my disposal, had available. This work was performed on a VAX 11/750. The second problem was that the model parameter estimates that Corbin used were not least squares estimates but the estimates described above. The obvious solution to both of these problems was to iterate on a solution. An iterative process converges toward the same solution as the closed form (cf. Faddeeva 1959) but with less computational difficulty and also allows for the use of traditional tabular method of estimating model parameters.

CHAPTER III
REDUCTION PROCEDURES

In the previous chapter, I have criticized the tabular procedure on three grounds: 1) the process is subjective in nature, 2) not all available model constraints are used and 3) the estimates for the model parameters are biased. The premise of this research is that by using all available model constraints, a more precise and accurate result is produced. Therefore, I have used the same subjective model and the same biased parameter estimates as Corbin used for my compilation of the NIRS. The differences in the two versions of the NIRS are thus due only to the fact that I have constrained the model parameters to minimize the systematic differences in star positions between independent catalogues as well as the systematic differences between independent catalogues and the FK4. The aim of this research was not to produce the best possible catalogue but rather to show that a simultaneous reduction produces superior results to those of the classical method.

Precession

The first step taken to recompile the NIRS was to precess all of the independent catalogue positions to the coordinate

system orientation of the FK4. The catalogues used in the recompilation of the NIRS are given in table 4 at the end of this chapter. The precession was carried out using Newcombs constants of precession. Three angles, ζ , z and θ, were computed for each catalogue epoch, these are (cf Eichhorn, 1974)

$$\begin{aligned}
\zeta &= [(23402.253 + 139.75t_i + 0.061t_i^2)t_f \\
&\quad + (30.23 - 0.27t_i)t_f^2 + 18.0t_f^3] \frac{\pi}{648000} \\
z &= \zeta + [(79.27 + 0.66t_i)t_f^2 + 0.32t_f^3] \frac{\pi}{648000} \qquad (12) \\
\phi &= [(20046.85 - 85.33t_i - 0.37t_i^2)t_f \\
&\quad - (42.67 + 0.37t_i)t_f^2 - 41.8t_f^3] \frac{\pi}{648000}
\end{aligned}$$

where t_i is the initial epoch of orientation relative to 1900.0 and t_f is the difference, final minus initial epoch of orientation. Both t_i and t_f are reckoned in Bessel millennia. The constant $\pi/648,000$ is necessary to convert from arcseconds to radians. Next, the IC positions are precessed to 1950.0 with the above angles and the following formulae

$$\begin{aligned}
X &= \cos\delta \, \cos(\alpha + \zeta - \tfrac{\pi}{2}) \\
Y &= \cos\delta \, \sin(\alpha + \zeta - \tfrac{\pi}{2}) \cos\theta + \sin\delta \, \sin\theta \\
Z &= -\cos\delta \, \sin(\alpha + \zeta - \tfrac{\pi}{2}) \sin\theta + \sin\delta \, \cos\theta \qquad (13) \\
\alpha_{50} &= \arctan (Y/X) + z + \tfrac{\pi}{2}
\end{aligned}$$

$\delta_{50} = \arctan\ (z/\sqrt{x^2 + y^2})$

where X, Y, and Z are temporary cartesian coordinates, and α, δ and α_{50}, δ_{50} are the right ascension and declination at the initial and final epoch respectively. A vector resolution arc-tangent function was used to insure the proper quadrant for α_{50}.

Model Parameter Estimation

After all IC positions had been precessed, the next step was to compute systematic corrections. Right ascensions are used in the following discussion but an analogous procedure was applied to declinations. It must also be noted that right ascensions were first multiplied by the cosine of the reference declination before differences were calculated. First differences in positions were computed for each star in each IC using the reference position and proper motion. These differences were summed over blocks of one hour by one degree centered on the hour and the degree. That is a block that covered 13^h would extend from $12^h\ 30^m$ to $13^h\ 30^m$. These sums are

$$\Delta\alpha(\alpha, \delta) = \sum_{\alpha-0^h\!.5}^{\alpha+0^h\!.5} \sum_{\delta-0^\circ\!.5}^{\delta+0^\circ\!.5} \frac{\cos\delta_{ref}}{s_r^2}[\alpha_{ref} - \mu_\alpha(1950.0-T_\alpha)-\alpha] \qquad (14)$$

where $\Delta\alpha(\alpha, \delta)$ is the systematic difference, s_r^2 is the estimated variance of the reference star position at the epoch of the IC position, α_{ref} and δ_{ref} are the reference

right ascension and declination, μ_α is the reference proper motion and α is the IC position observed at epoch T_α. The estimated variance of an FK4 position was calculated using the errors and central epoch given in the FK4 and the epoch of the IC position. The variance for an NIRS position was calculated in a like manner except that an additional variance term was included to represent the error of the system of the NIRS. That is, the reference system of the FK4 is defined only in terms of the set of FK4 stars. If that set of stars is altered, then the ideal reference system, which the altered set approximates, is no longer exactly that of the FK4. Even though the system of the NIRS is an approximation to that of the FK4, they are not identical. Therefore, the variance of an NIRS position consists of two parts. The first is due to the error of the star position within the system of the NIRS and the second is due to the error of the system of the NIRS itself.

In order to estimate the variance due to the error of the system of the NIRS, the Perth 70 and Corbin's version of the NIRS were used. After matching 3324 stars between the Perth 70 and the NIRS, the one sigma dispersion of Perth 70 positions and the NIRS predictions of the Perth 70 were found to be 0.22 arcseconds in right ascension and 0.30 arcseconds in declination. This dispersion is due to the position errors within the catalogues as well as the errors of the systems of the catalogues. Since the mean error of a

position is published in each catalogue, the errors of the the systems of the catalogues can be estimated.

$$d^2 = \varepsilon^2_{NIRS} + \varepsilon^2_{P70} + \varepsilon^2_{SNIRS} = \varepsilon^2_{SP70} \tag{15}$$

The square of the dispersion, d^2, is the sum of the squares of the mean errors of a catalogue position, ε^2_{NIRS} and ε^2_{P70}, plus the squares of the estimated errors in the catalogue systems, ε^2_{SNIRS} and ε^2_{SP70}. The residual variance could be split equally between the systems of the two catalogues, but I chose to have the ratio of system errors equal the ratio of the mean position errors. The system error used for an NIRS position was .064 arcsecond in right ascension and .070 arcsecond in declination.

Once tables of differences for each IC were calculated, these differences were smoothed with adjacent differences according to the following scheme:

$$\Delta'\alpha(\alpha,\delta) = \frac{\sum_{i=-3^h}^{+3^h} \sum_{j=-6^\circ}^{+6^\circ} A_i B_j \Delta\alpha(\alpha + i,\ \delta + j)}{\sum_{i=-3^h}^{+3^h} \sum_{j=-6^\circ}^{+6^\circ} A_i B_j\ n(\alpha + i,\ \delta + j)} \tag{16}$$

where A_i and B_j are the smoothing coefficients in table 2 and $n(\alpha, \delta)$ is the sum of the reciprocal variances for the appropriate IC, hour and degree. The smoothing coefficients used (regular or light) for each catalogue are listed in table 4. After differences have been summed and smoothed, they are then averaged over zones of five degrees:

$$\Delta''\alpha(\alpha,\delta) = \frac{\sum_{j=-2^\circ}^{+2^\circ} D_j \Delta'\alpha(\alpha_1\delta + j)}{\sum_{j=-2^\circ}^{+2^\circ} D_j} \tag{17}$$

where D_j is the denominator in equation (16) of the associated $\Delta'\alpha(\alpha, \delta)$.

TABLE 2

Smoothing Coefficients

Regular				Light			
i	A_i	j	B_j	i	A_i	j	B_j
0^h	4	0°	10	0^h	8	0°	10
1^h	2	1°	8	1^h	3	1°	8
2^h	1	2°	8	2^h	0	2°	5
		3°	5			3°	2
		4°	5			4°	0
		5°	2			5°	0
		6°	2			6°	0

Once tables of systematic differences are computed for each catalogue, they were applied to the IC positions as systematic corrections using two-way linear interpolation. Right ascensions were first multiplied by the cosine of the declination, corrected and then divided by the cosine of the declination.

Star Parameter Estimation

After correcting the systematic errors of the ICs, the position and proper motion were calculated for each star

using a weighted least squares algorithm. Corbin (1982) calculated weights for each IC used in the construction of the NIRS using three different methods. Method A was based on the deviations of an IC from the final NIRS compiled with each catalogue receiving equal weight. Method B was similarly based on deviations from a mean NIRS but this time the mean NIRS was compiled without the particular IC whose weight was being determined. Method C was based on the deviations of an IC from the reference system which was used to calculate its systematic corrections. Corbin then used the arithmetic mean of these three methods in the final compilation of the NIRS. I have used these same weights, listed in table 4, in my compilation of the NIRS.[1]

The following algorithm was used to calculate star parameters. First the central epoch, $\overline{T}$, and position, $\overline{P}$, were calculated:

$$\overline{P} = \frac{\sum_{i=1}^{l} w_i P_i}{\sum_{i=1}^{l} w_i}$$

$$\overline{T} = \frac{\sum_{i=1}^{l} w_i T_i}{\sum_{i=1}^{l} w_i} \tag{18}$$

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[1] For a discussion of selecting weights used in catalogue compilation, see Khrutskaya 1980.

where T_i is epoch and P_i is the position of the star in catalogue i and w_i is product of the the weight associated with catalogue i and the number of observations for that IC position divided by the mean number of observations per IC position for that IC. Next the T_i were referenced to the central epoch:

$$T_i' = T_i - \overline{T} \tag{19}$$

and the proper motion was calculated:

$$\mu = \frac{\sum_{i=1}^{l} w_i T_i' P_i}{\sum_{i=1}^{l} w_i T_i'^2} \tag{20}$$

Finally, estimates for the variance of the position and proper motion, V and V_μ, were calculated:

$$V = \frac{\sum_{i=1}^{l} w_i (P_i - \overline{P} - \mu T_i')^2}{(l - 2) \sum_{i=1}^{l} w_i}$$

$$V\mu = \frac{\sum_{i=1}^{l} w_i (P_i - \overline{P} - \mu T_i')^2}{(l - 2) \sum_{i=1}^{l} w_i T_i'^2} \tag{21}$$

<u>Sequence of Iterations</u>

Now that the basic mechanics of the reduction have been described, a discussion of the iteration sequence is in order. Within an iteration the first step was to eliminate

outliers (IC positions with large residuals), the second was to determine and apply systematic corrections and the third was to compile a new version of the NIRS.

Corbin used several criteria for selection of AGK3R stars to use in the NIRS. Among these was the requirement that a star with only two observations must have those two observations separated by a minimum of 28 years. Because of the convolution of these criteria with the selection of outliers, I chose those stars which appeared in Corbin's final NIRS catalogue to use in the compilation of my version of the NIRS. This, however, did not eliminate the problem of identifing the outliers.

In duplicating the model and method used by Corbin, I chose the same criterion for rejecting outliers. Corbin rejected an IC position if the absolute value of its residual was 3.5 times the mean absolute residual for positions in that catalogue. Corbin established residual limits for each IC and I have used these same pre-set limits in my compilation of the NIRS. Residual limits for each IC are listed in table 4.

The problem here is that one must compute systematic corrections before residuals can be analyzed. In using an IC position with a large residual to calculate corrections, the corrected system of a catalogue can be distorted such that other positions, which would not normally be excluded, now exceed the residual limit. I decided to take an

iterative approach to this problem. The largest outliers were removed first such that the systems of the catalogues were not influenced by them in the next iteration. Then the residual limit was lowered and the next largest outliers were removed. This process was repeated until the residual limit was lowered to that of the individual catalogues. In iterations one and two, no IC positions were removed. In iteration three, only IC positions whose residual absolute values were greater than five arcseconds were removed. The iteration residual limit was lowered in succesive iterations as given in table 3 until the residual limit for an IC was the individual limit given in table 4.

For the first iteration, the only reference system was the FK4. Only catalogues 1 through 10 had FK4 observations, thus only these first ten catalogues were corrected. For the second iteration, the reference system included the FK4 as well as 6317 NIRS positions and proper motions computed in the first iteration, thus allowing all ICs to be corrected. For the third and subsequent iterations, the reference system included the FK4 and 20194 NIRS positions and proper motions.

Only the first ten ICs were corrected in the first iteration; thus for the first computation of the NIRS, only positions from the first ten ICs were used. In addition, only those stars with three or more IC positions were compiled into the first version of 6317 NIRS positions and

TABLE 3

Iteration Sequence

Iteration	Residual[a] Limit	Number of Stars Compiled into NIRS
1	none	6317
2	none	20194
3	5.0"	20194
4	2.0"	20194
5	1.8"	20194
6	1.6"	20194
7	1.4"	20194
8	1.2"	20194
9	1.0"	20194
10	0.8"	20194
11	0.6"	20194
12	0.4"	20194
13-25	b	20194

a. The residual must be greater in absolute value than both the iteration residual limit and the individual catalogue limit in table 4 in order for an IC position to be rejected.

b. For the 13th through 25th iterations the individual catalogue limits in table 4 were used.

proper motions. For the second and subsequent iterations, all IC positions were used to calculate 20194 NIRS positions and proper motions.

Tables 5 through 68 at the end of this chapter give the corrections applied to the independent cataolgues for my compilation of the NIRS. Each IC position was corrected with values from this table using two-way linear interpolation. The units are hundredths of arcseconds and the right ascensions corrections have been multiplied by the cosine of the declination. Furthermore, corrections whose

absolute values exceeded 99 hundredths of an arcsecond were replaced by 99 hundredths with the appropriate sign.

TABLE 4
Independent Catalogues Used in the Compilation of the NIRS

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
1	AGK3R	Catalog of Reference stars for the Dritter Katalog der Astronomischen Gesellschaft	1.00	1.00	0.46	0.45	regular
2	AGK2A	Katalog der Anhaltsterne für das Zonenunternehmen der Astronomischen Gesellschaft	0.52	0.36	0.53	0.68	regular
3	W20	Catalogue of 9989 Standard and Intermediary Stars	0.26	0.46	0.71	0.62	regular
4	Albany 10	Albany Catalog of 20811 Stars for the Epoch 1910	0.21	0.32	0.83	0.71	regular
5	Bonn 00	Katalog von 10633 Sternen	0.25	0.46	0.73	0.59	regular
6	Bord 50	Catalogue Méridien de 2024 Étoiles Repères de la Zone +11° a +18°	0.70	0.64	0.41	0.50	regular
7	Sch	Katalog von 3356 schwachen Sternen	1.00	0.88	0.36	0.45	regular
8	Bonn 25	Katalog der Intermediären Sterne von +50° Declination bis zum Nordpol	0.23	0.31	0.68	0.71	regular
9	W2-50	Catalog of 5216 Stars for 1950.0	1.05	0.69	0.42	0.59	regular
10	W3-50	Catalog of 5965 Stars for 1950.0	1.09	0.88	0.42	0.50	regular
11	GCH 1-50	First Greenwich Catalogue of Stars for 1950.0	0.42	0.45	0.62	0.62	light

TABLE 4 CONTINUED

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
12	Cape02 00	Cape General Catalogue of Stars for 1900.0	0.22	0.32	0.71	0.68	regular
13	Nice 10	Catalogue Deduit dés Positions Observées a l'aide du Cercle Méridien de l'Observatoire de Nice de 1912 a 1914	0.30	0.29	0.56	0.68	light
14	Nice 25	Catalogue De 1020 Étoiles Intermediaires	0.59	0.34	0.45	0.62	light
15	GCH Z 10	Greenwich Catalogue of Stars for 1910.0	0.13	0.22	0.86	0.77	light
16	Paris 90	Catalogue de l'Observatoire de Paris, Seconde Partie	0.04	0.07	1.50	1.20	light
17	Paris 00	Paris Catalogue de 10656 Étoiles de Repère de la Carte du Ciel	0.07	0.19	1.13	0.89	regular
18	GCH 2-25	Second Greenwich Catalogue of Stars for 1925.0	0.35	0.41	0.59	0.65	light
19	Berl 20	Berlin-Babelsberg Katalog von 8803 Sternen zwischen 31° und 40° Nördlicher Deklination	0.28	0.19	0.65	0.89	light
20	GCH 00	Greenwich Second Nine-year catalogue of Stars for the Epoch 1900.0	0.25	0.34	0.68	0.59	light
21	Toul3 00	Troisème Catalogue de Toulouse	0.30	0.47	0.65	0.56	light

TABLE 4 CONTINUED

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
22	Cape 2-25	Second Cape Catalogue of Stars for the Equinox 1925.0	0.30	0.39	0.65	0.62	light
23	Cape 3-25	Third Cape Catalogue of Stars for the Equinox 1925.0	0.38	0.51	0.56	0.53	regular
24	W 40	Washington Results of Observations made with the nine-inch Transit Circle	0.77	0.78	0.50	0.41	regular
25	W 00	Washington-Results of Observations with the Nine-inch Transit Circle 1903-1911	0.28	0.41	0.65	0.53	regular
26	W ZOD 25	Washington-Catalog of 3520 zodiacal Stars based on Observations with the Six-inch Transit Circle 1928-1930	0.35	0.37	0.63	0.68	regular
27	Cape 1-50	First Cape Catalogue of Stars for the Equinox 1950.0	0.88	1.31	0.50	0.35	light
28	Bord 00	Second Catalogue de L'Observatoire de Bordeaux	0.07	0.13	1.24	0.92	regular
29	ALB99 00	Albany Zone Catalogues for the Epoch 1900 - Catalogue of 2800 stars between 2° of South and 1° of North Declination	0.11	0.20	0.83	0.68	regular
30	Mun97 00i[b]	München Sternwarte - Katalog von 1867 Sternen (+37°.5 to +47°.5)	1.13	1.29	0.39	0.35	light

TABLE 4 CONTINUED

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
31	Mun97 00ii[b]	München Sternwarte - Katalog von 1867 Sternen (+55° to +60°)	1.14	0.83	0.35	0.40	regular
32	Kon 00[c]	Königsberg - Rektaszensions - Beobachtungen von 4066 Sternen	0.45	0.00	0.56	0.00	regular
33	Pulk99 00	Pulkovo - A Catalogue of 8820 Stars between 5° South and 15° North Declination	0.07	0.19	1.20	0.80	regular
34	Madn 10	Madison Catalogue of 2786 Stars for the Epoch 1910	0.17	0.17	0.85	0.80	light
35	Berg 1-25	Erstes Bergedorfer Sternverzeichnis 1925.0	0.33	0.20	0.53	0.80	regular
36	ABB-6 00	Abbadia - Catalogue de 7443 Étoiles	0.13	0.17	0.71	0.71	light
37	Buch 50	Bucharest KSZ Catalogue of Faint Stars for 1950.0	0.49	0.34	0.62	0.80	light
38	Bonn09 00	Bonn Katalog von 2199 Sternen für 1900.0	0.17	0.51	0.71	0.56	regular
39	ABB+20 00	Abbadia - Catalogue de 14263 Étoiles	0.17	0.28	0.86	0.62	light
40	ABBO 00	Abbadia - Catalogue de 13532 Étoiles	0.14	0.17	0.86	0.80	light
41	Lund44 50	Meridian Observations of Faint AG Stars	0.12	0.13	1.00	1.05	light

TABLE 4 CONTINUED

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
42	Stras 30	Strasbourg Catalogue de 2251 Étoiles Faibles	0.39	0.21	0.60	0.80	light
43	Cin 00	Cincinnati Catalog of 4683 Stars for the Epoch 1900	0.12	0.10	1.00	1.10	regular
44	PFKSZ	Preliminary General Catalogue of Fundamental Faint Stars	1.87	1.46	0.40	0.40	regular
45	Lund42 50	Meridian Observations of Miscellaneous Stars	0.16	0.08	0.75	1.40	regular
46	Cin 25	Cincinnati Catalog of 2300 Stars for the Equinox 1925.0	0.11	0.12	0.92	0.90	regular
47	Moscow 50	Catalog of Faint Stars	0.26	0.32	0.80	0.80	regular
48	Tri 25	Catalogo di 2390 Stelle Osservate al Cerchio Meridiano	0.09	0.07	1.10	1.20	light
49	Bruss 25	Brussels - Catalogue de 1339 Étoiles Fondamentales	0.40	0.32	0.55	0.66	regular
52[a]	Leid21 25	Leiden - A Catalogue of the Positions and Proper Motions of 1533 Red Stars	0.29	0.26	0.55	0.60	light
53	Leid24 25	Leiden - General Catalogue of Positions and Proper Motions of 1190 Standard Stars	0.76	0.82	0.40	0.40	regular

TABLE 4 CONTINUED

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
54	Lund 25	Katalog von 11800 Sternen der Zone +35° bis +40° AG Lund	0.11	0.16	1.05	1.00	light
55	Leid27 25	A Catalog of 1073 Stars in the Zone of North Declination 55° to 60°	0.34	0.20	0.50	0.67	regular
56	Berl Z 10	Katalog von 1886 Sternen zwischen +79° und +90°	0.35	0.17	0.59	0.80	regular
57	Kon19 25	Königsberg-Katalog von 2043 Sternen	0.38	0.47	0.70	0.55	light
58	Toul3 00-I	Appendice II du Troisième Catalogue de Toulouse	0.11	0.15	0.89	0.80	regular
59	Pulk 10	Katalog von 3396 Sternen zwischen 39° und 46° nördlicher Deklination	0.30	0.44	0.59	0.56	light
60	Lick 17	Publications of the Lick Observatory, Vol. XV	0.67	0.73	0.35	0.41	regular
61	Lick 28	Meridian circle Observations of 1188 Stars between 20° and 30° North Declination	0.47	0.35	0.56	0.62	regular
62	Turin 10[c]	Catalogo d'Ascensioni Rette di 697 Stelle fisse	0.11	0.00	0.90	0.00	regular
63	Bord 00-II	Nouvelles Observations Des Étoiles contenues dans le Second Catalogue de l'Observatoire de Bordeaux	0.10	0.14	0.89	0.86	light

TABLE 4 CONTINUED

(A)	(B)	Title	(C)	(D)	(E)	(F)	(G)
64	Ottw28 25	Results of Observations made with the Reversible Meridian Circle 1923-1935, Catalogue of 1589 Stars	0.54	0.34	0.53	0.60	regular
65	Ottw42 50	Results of Observations made with the Reversible Meridian Circle 1935-1950, Catalogue of 1525 Stars	0.54	0.32	0.53	0.62	regular
66	Kon17 25	Katalog von 546 Sternen	0.43	0.38	0.50	0.60	light

(A) Catalogue reference number as provided by Corbin
(B) Catalogue abbreviation as given by Corbin
(C) Right ascension weight
(D) Declination weight
(E) Right ascension residual limit in arc-seconds
(F) Declination residual limit in arc-seconds
(G) Smoothing coefficients used
a. Reference numbers 50 and 51 have no catalogue associated with them.
b. The Mun97 00 was observed in two seperate zones and is treated as two seperate catalogues.
c. The Kon 00 and the Turin 10 are transit instrument observations of right ascensions only.

TABLE 5

Corrections Applied to the AGK3R

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	1	0	0	0	-1	-5	-1	3	-2	0	-4	1	2	0	4	7	6	2	1	-1	4	5	11	5
85	0	0	0	0	-1	-1	0	1	-1	0	0	-3	-1	0	1	3	2	0	0	-5	0	0	1	-1
80	-1	-3	0	0	1	2	1	-1	0	0	0	-5	-2	-5	0	1	1	0	0	2	2	4	2	-1
75	-1	-2	-2	-2	1	2	0	-1	-2	0	0	1	3	2	1	0	0	-4	-2	-2	3	4	2	-5
70	-2	1	-2	0	3	11	5	3	2	3	1	3	1	1	0	-4	-1	-3	-3	-1	5	7	2	0
65	-4	-7	-9	-4	-2	3	2	7	5	6	2	2	-5	-5	-1	-1	4	3	-2	-2	1	4	3	0
60	1	-1	-1	4	1	3	-1	5	-2	1	0	6	1	0	-6	-2	-2	0	-1	0	4	2	2	1
55	1	1	1	2	-4	4	0	0	-4	-2	1	1	0	2	-3	-1	-1	1	1	3	6	1	-1	0
50	1	2	0	-1	-8	-4	-1	0	-3	3	2	3	1	3	2	2	1	6	0	2	-6	0	-5	2
45	3	1	4	-1	4	1	6	4	5	3	1	2	5	3	1	2	-1	5	2	8	3	7	1	4
40	5	0	4	-1	2	-7	-1	0	2	-3	-2	-5	-4	-2	-5	5	0	5	2	5	2	0	-5	1
35	5	4	-3	-5	-4	-5	-2	-5	1	-1	2	-1	-1	-2	-7	-3	-7	-7	-4	-5	-2	-3	0	2
30	5	8	0	0	-1	-1	-1	-2	0	0	2	1	2	1	-1	0	2	4	14	6	5	-6	-1	1
25	2	1	-2	-2	-1	-2	-1	-1	1	2	2	1	0	0	0	1	3	4	11	6	3	-3	-1	1
20	0	0	0	-1	2	-2	-1	-3	1	2	1	-2	-2	-8	0	1	2	1	-2	0	0	-1	-1	-2
15	1	2	1	6	2	-5	0	1	4	7	2	2	0	-3	0	2	5	1	0	0	6	2	1	1
10	2	3	4	2	1	-2	4	2	7	4	2	-4	-1	0	6	3	3	1	0	-6	0	0	4	1
5	-6	-3	-2	-2	-3	-6	4	0	3	4	2	5	0	1	2	2	3	1	1	0	0	1	2	-1
0	-1	-2	-3	-4	-6	-4	-5	-2	-1	2	0	5	0	4	4	6	-1	-1	1	5	0	0	0	1
-5	2	6	3	0	-3	1	-2	0	0	0	-3	-1	-1	1	-4	-2	-6	-4	-1	1	0	-4	-5	0
-10	-8	1	3	3	0	0	6	4	10	10	-7	-1	-2	6	-12	4	-4	2	6	6	9	6	-4	-2

TABLE 5 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	-15	-1	-3	-2	-46	-4	-4	17	7	-7	-26	14	18	8	8	8	4	1	-11	-20	-25	-22	-4
85	26	0	-10	3	7	-15	11	-2	10	-1	14	-6	12	-1	-15	-1	12	12	7	-15	-11	-5	-3	19
80	-26	1	-8	4	4	0	1	-5	7	8	17	5	7	-3	-10	-9	-9	-8	-9	-9	-7	8	-9	-7
75	-33	-11	-5	1	-2	-7	-10	-8	1	-7	-11	-6	-1	2	2	-1	-6	-3	3	2	-1	-1	2	-6
70	6	2	10	-1	-2	-7	-3	0	6	4	6	0	1	1	0	5	-1	3	9	6	5	0	11	7
65	4	4	8	3	2	7	4	0	8	10	9	-3	-4	0	0	-4	-4	0	2	2	-3	1	-2	-1
60	-7	-2	-5	-5	2	8	1	-6	0	4	6	-3	3	11	5	-2	-1	6	3	3	-2	3	-6	-2
55	-3	-2	-2	-3	-2	1	-1	0	1	2	2	-2	-1	2	2	-5	0	1	8	5	-3	-4	-8	-3
50	-7	-2	-1	2	-2	2	3	7	0	-9	-9	-6	0	3	7	3	2	6	5	7	-3	-8	-5	-6
45	-2	-3	0	3	0	1	3	9	3	-1	-3	-1	0	0	5	0	-3	4	-4	5	5	1	4	-1
40	0	-2	-1	-2	-3	-2	0	3	8	6	3	-2	0	-1	-1	-1	0	7	-3	-8	-2	0	2	-1
35	3	2	3	2	1	1	0	-5	-1	-1	4	-3	1	0	3	-1	-3	2	1	-1	-1	-5	-3	-3
30	-1	2	8	3	-2	-10	-8	-8	0	-4	1	-3	-2	-3	-2	0	3	6	9	-4	0	-2	-4	-4
25	2	2	3	3	6	0	0	5	2	6	3	5	-1	-2	-2	-1	2	3	6	1	2	4	0	2
20	0	1	1	3	2	0	-1	0	-1	-8	-8	-8	-3	-2	1	0	-1	-1	1	2	-1	-1	-2	-1
15	-5	-8	-6	-2	-1	-2	-4	0	3	1	2	0	-1	-7	-7	-4	-1	-1	-3	-2	-7	-6	-3	-6
10	0	-7	-3	-1	6	5	6	0	6	9	7	9	4	5	1	7	7	4	3	2	7	-2	0	-3
5	0	-6	6	0	3	-5	0	-6	-1	-5	-2	3	2	1	-2	0	6	1	-5	0	-3	-2	1	-5
0	2	-2	7	5	1	0	-3	0	1	3	0	2	0	-2	-8	-9	-1	1	4	10	8	11	12	4
-5	1	-12	-2	-1	1	2	5	5	-2	0	2	2	4	7	8	-2	1	1	11	11	2	-1	6	2
-10	15	-22	2	-3	1	-1	0	-7	-12	3	8	9	3	-5	6	-7	-9	-10	-5	2	-10	-4	-1	-6

TABLE 6

Corrections Applied to the AGK2A

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	13	9	6	3	11	64	26	-5	-2	29	62	53	44	15	-8	-31	16	10	15	4	-35	-51	-48	9
85	-1	-2	-15	-20	-17	29	12	-3	1	4	-7	8	13	23	25	24	39	9	0	-17	-39	1	-5	12
80	17	5	6	3	0	7	5	12	21	13	-12	11	7	22	6	5	2	7	-4	-15	4	5	9	6
75	28	4	18	24	16	17	12	19	18	32	15	23	9	8	6	1	-3	5	-1	-1	6	-17	2	3
70	14	8	14	18	14	12	10	15	22	22	22	11	7	0	8	3	-1	-5	-3	-4	-3	-13	1	1
65	11	13	21	21	14	10	10	14	23	12	26	14	14	6	5	3	0	-10	-5	10	-2	-2	-9	9
60	4	7	11	14	9	7	11	12	23	11	19	16	18	1	1	1	1	-3	-13	-6	-12	-1	-3	7
55	4	11	7	5	8	7	3	14	18	22	13	11	10	-3	0	-1	2	-4	-4	-13	-6	-5	-2	4
50	5	4	6	0	4	0	4	8	15	11	7	15	2	2	-6	-5	-13	-10	-4	-3	4	-10	-8	-4
45	5	1	-3	-8	-6	-6	-3	-4	2	5	0	2	-11	-5	-6	-1	-6	-3	-2	-1	-7	-13	-11	-5
40	4	2	-6	-8	-8	4	5	5	-5	11	6	8	-2	-2	-11	-6	-4	-6	2	-5	-8	-6	-7	-7
35	-6	-5	2	-11	-7	-4	-3	1	-14	-7	7	3	5	-4	-4	-10	-5	-13	-5	-3	-1	-8	-18	-17
30	-6	6	5	-5	-2	-6	4	4	0	1	13	8	4	-9	2	-4	2	-4	6	-2	7	-2	-4	-12
25	-2	2	-1	4	-1	-6	-6	1	-3	6	5	6	3	-5	-5	-4	-10	-9	3	9	7	3	2	-3
20	1	4	7	6	4	-2	-1	-1	1	5	14	4	4	-11	-8	-5	-9	-7	-6	12	4	-5	-3	5
15	-5	-4	8	-2	-3	-8	-3	-4	-3	-4	1	5	-4	-8	-4	0	-7	-5	-5	2	-4	2	-1	-2
10	5	0	1	0	-1	-6	-9	-10	-2	-2	-3	2	-7	-2	7	-1	-13	-11	-6	8	-1	5	1	-5
5	4	1	3	-4	1	-4	-6	-5	5	4	11	8	-4	0	2	-3	-11	-11	1	3	10	6	3	-1
0	-5	1	7	0	1	-1	2	-2	1	1	8	9	0	0	-6	-3	-6	-6	-7	-2	6	14	3	1
-5	-2	6	6	4	0	-3	5	6	10	2	6	15	5	5	1	1	-3	-2	-2	5	-3	10	5	9
-10	2	-4	4	-5	-3	-9	-6	-3	4	-5	-3	-2	5	3	15	8	6	5	1	3	-4	2	0	-11

TABLE 6 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-13	-12	1	28	0	15	0	-10	-16	4	25	39	-52	-32	-2	-1	4	-4	-5	8	31	24	-5	-39
85	14	5	5	30	-3	12	19	13	5	5	-4	18	-26	13	45	-4	6	-6	-3	5	20	-1	20	2
80	-3	1	-6	-3	7	8	11	6	9	15	-4	9	-9	14	16	-4	0	0	-5	-13	-11	-17	2	-7
75	-16	1	-6	-12	1	12	-3	-8	-11	9	6	17	9	7	-2	3	-3	1	-8	-7	-9	1	-11	-6
70	10	12	2	7	10	3	-11	4	27	10	2	0	5	-2	-7	-10	-5	-4	-1	0	-8	-2	-1	9
65	-2	-16	-8	-16	15	-9	-9	-10	15	5	3	-2	-3	7	8	3	6	-4	2	-9	-2	-10	3	-7
60	-1	0	4	-13	10	0	17	-3	-3	-4	-4	5	5	2	7	5	5	-7	1	-1	3	-3	-2	-10
55	1	0	3	1	7	4	6	5	-4	2	-8	1	-5	-9	-2	7	6	-6	5	6	9	0	4	4
50	2	-1	-1	-1	0	-6	7	-6	-1	14	-4	1	-3	4	-6	-4	-9	-6	-8	-11	4	-1	6	18
45	0	6	4	1	0	-4	3	-9	3	5	2	-6	-6	4	5	1	6	-2	4	0	-1	0	-2	-3
40	-5	-2	-2	3	3	2	-1	-1	5	4	10	-8	1	-7	-6	0	7	-12	6	6	6	-6	-7	-4
35	-10	2	-2	-4	0	2	-15	-5	-3	-3	2	-3	2	-8	-19	-2	7	-14	-6	-7	-3	-9	-11	-6
30	-2	9	8	-2	0	-2	-8	-6	3	-10	-12	-18	4	21	2	5	9	6	0	4	0	1	-7	-7
25	-6	3	7	7	3	5	9	6	2	0	8	-15	-14	-12	-9	3	2	11	-13	9	-4	0	-1	6
20	4	-6	3	-8	-5	-9	2	-3	11	-2	0	-4	-2	-10	-5	9	-3	6	-10	10	-3	0	-4	-4
15	12	4	16	0	4	-3	8	6	25	11	8	2	5	14	13	13	4	2	6	6	-1	-5	-12	-19
10	13	-5	-5	-1	2	6	-6	4	-6	3	1	-1	-3	-1	17	14	15	-1	0	-11	-3	-12	-1	-7
5	3	-1	-1	-6	-5	4	1	17	9	8	-6	-18	-4	-4	9	9	6	-12	1	-10	-2	-14	-15	-14
0	-3	-6	-3	-12	-7	-11	-2	2	-3	6	-6	-9	4	-6	1	7	8	-14	-3	-15	2	-9	2	-7
-5	-20	-7	-4	-15	-8	-5	-5	-6	-10	0	-9	-23	-16	-7	-12	6	5	2	5	-1	1	-7	-17	-13
-10	-15	-11	7	-6	8	2	0	-1	3	14	7	-2	-3	30	-7	3	-9	4	8	16	7	13	5	11

TABLE 7

Corrections Applied to the W20

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-10	-14	-14	-12	-5	6	-5	-3	3	7	-6	-11	-36	-14	-8	-19	-7	-1	4	-6	-20	-49	-35	-17
85	32	8	4	-7	-1	-1	-5	0	10	19	3	-4	-9	11	20	-15	-27	-27	-2	12	-3	-11	-4	15
80	-2	-6	-14	-42	-23	-33	-17	-29	-26	-24	-6	-18	15	-16	-14	-28	-12	11	27	22	-30	-13	-14	-1
75	-37	-39	-40	-35	-32	-39	-27	-54	-41	-54	-15	-45	-8	-71	-34	-62	-57	-37	-49	-36	-50	-5	-14	-11
70	-19	-32	-36	-24	-29	-9	-36	-44	-33	-38	-37	-45	-34	-34	-4	-18	-53	-29	-47	-5	-23	-24	-38	-26
65	-34	-45	-42	-21	-48	-14	-41	-67	-63	-75	-66	-41	-29	-38	-21	-36	-62	-27	-63	-16	-20	-59	-44	-31
60	-38	-32	-13	46	-13	-16	-35	-63	-42	-43	-9	-27	-43	-75	-40	-22	-3	-52	-59	-75	-26	-57	-26	-11
55	-19	-38	-43	-27	-39	-32	-41	-27	-22	-61	-28	-70	-29	-46	-48	-44	-42	-29	-56	-27	-17	-64	-39	-30
50	-61	-19	-29	-15	-43	-49	-30	-32	-12	-50	-41	-55	-36	-17	-28	-17	-41	-5	-48	1	-9	-41	-58	-53
45	-53	-9	-54	-38	-55	-40	-41	-45	-8	-25	-59	-33	-65	-52	-39	-27	-33	-41	-15	-39	-26	-22	-9	-16
40	-39	-43	-84	-40	-26	-14	-36	-42	-4	-20	-45	-26	-29	-22	-11	-21	-20	-4	11	-15	-24	-40	-12	-24
35	-12	8	-19	5	-13	7	-9	-21	-40	-15	-19	-10	-16	12	29	-35	-1	-45	-26	-15	-10	-17	-7	-31
30	-42	-33	-42	-26	-40	-25	-7	-32	-17	-19	-23	-46	-51	-39	2	-35	-26	-45	-40	-39	-31	-32	-20	-43
25	-25	-54	-39	-38	-30	-48	-26	-47	-23	-32	-28	-42	-28	-19	11	-20	-63	-44	-33	-21	-19	-43	-64	-32
20	-44	-64	-50	-35	-43	-40	-33	-44	-41	-62	-78	-42	-36	-42	-35	-46	-38	-35	-33	-40	-41	-37	-47	-17
15	-49	-66	-67	-39	-40	-35	-46	-54	-66	-61	-82	-41	-39	-37	-33	-31	-43	-27	-36	-46	-62	-73	-46	-41
10	-49	-60	-56	-50	-50	-32	-56	-57	-68	-37	-52	-53	-40	-60	-49	-66	-48	-55	-50	-57	-51	-58	-38	-47
5	-56	-57	-52	-60	-67	-43	-55	-58	-71	-42	-69	-63	-55	-62	-62	-57	-45	-52	-55	-42	-43	-54	-51	-51
0	-55	-47	-49	-51	-70	-74	-58	-86	-76	-54	-87	-54	-63	-44	-32	-52	-70	-78	-81	-86	-58	-65	-61	-57
-5	-64	-48	-52	-53	-64	-62	-46	-54	-60	-73	-90	-66	-71	-63	-32	-60	-42	-42	-41	-70	-51	-64	-58	-55
-10	-77	-60	-65	-62	-40	-64	-54	-81	-45	-78	-16	-30	-19	-75	-50	-62	-36	-39	-57	-41	-46	-55	-62	-50

TABLE 7 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-3	7	-17	-10	-2	36	9	-8	-6	-3	0	17	-29	-20	-16	-17	-17	-11	3	-5	27	11	2	-27
85	2	9	-13	-5	-5	23	8	9	14	14	10	11	-6	22	39	22	-9	1	1	-14	15	18	0	-31
80	33	0	-1	8	-3	-9	1	-7	14	14	-4	-24	12	10	0	-4	-13	13	5	30	-33	11	-13	-4
75	41	4	5	-2	13	-10	28	-26	-4	19	-1	-24	2	-2	-19	-20	12	14	-2	36	-15	12	-11	1
70	17	11	20	32	35	3	23	-8	-8	-21	-1	-21	7	-14	-9	-8	35	-5	-8	-26	5	28	26	19
65	-16	-11	-25	2	10	-4	-7	-26	-28	-17	1	0	26	-25	-18	-13	8	-26	2	-4	-2	23	17	-14
60	7	19	-7	-20	2	11	31	-8	-6	-2	-6	-25	14	-27	-20	-34	18	16	-3	10	-11	20	2	14
55	-7	-3	12	4	-1	-7	5	-26	-3	-12	-10	-27	-23	27	-3	-15	-8	3	-19	-13	-5	15	-5	38
50	-34	-34	2	-17	-1	10	-15	-2	-18	17	-12	-22	3	13	-11	-30	-27	-1	-4	3	13	2	9	-33
45	-10	-5	12	5	-16	9	-19	7	-4	12	-21	-17	21	1	-15	-7	-13	15	-11	-10	-16	-8	15	2
40	3	-12	-4	12	-11	37	7	7	-9	-12	1	-20	-3	-22	-1	16	-12	-20	-4	-14	-5	-5	-4	8
35	-1	10	-7	6	-28	-39	-41	-4	12	-5	-15	-16	18	-14	-9	-23	-27	-10	-3	-22	-1	3	-17	1
30	-6	22	15	-9	-2	1	-9	0	-13	-11	-24	-41	-7	-13	23	-9	1	-5	-11	-22	-11	3	-4	5
25	-8	11	-5	-13	5	4	-17	2	-10	18	0	8	-20	-7	10	-7	3	-13	-15	3	9	2	-7	0
20	-2	1	-5	-4	-2	-4	-6	-5	-7	-21	-18	4	-20	-13	-8	-13	-5	0	-16	-3	-14	-12	-26	1
15	2	-20	0	-7	-1	-22	-7	-8	2	-20	6	-8	-13	-11	6	-22	3	-7	-5	-12	-13	-19	1	5
10	-8	-4	-12	-3	-13	3	10	-2	5	-5	4	3	3	2	21	-1	27	-13	1	-8	2	-9	2	-5
5	6	28	-7	-1	-17	10	-2	-7	-5	-25	-12	-6	-4	-18	-28	-5	15	1	-11	0	-13	1	-8	2
0	-8	12	-17	5	-39	-16	-13	-5	2	-10	4	4	2	0	21	-3	-4	-3	-15	4	8	10	14	9
-5	-30	-14	-13	-1	-5	-6	26	-5	10	-5	-13	-12	-3	-11	23	-8	-1	4	-4	16	-11	6	7	6
-10	1	32	-5	6	2	13	22	-14	-3	-13	15	3	37	-33	10	-11	5	8	6	49	-10	8	-12	7

TABLE 8
Corrections Applied to the Albany 10

dec\ra (Right Ascension)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-3	8	-10	6	-19	6	-7	3	-20	3	3	99	46	47	-38	-6	-1	-4	-8	-12	-24	-13	4	21
85	-25	-10	-32	5	-26	-6	-26	-2	-29	-2	-66	35	-31	16	-38	-9	-4	1	5	-16	-32	-25	-11	5
80	-39	-48	-60	-29	-39	-30	-41	-27	-29	-19	-53	-25	-18	-25	-37	-32	-31	-32	-46	-40	-43	-37	-40	-45
75	-42	-28	-53	-31	-40	-39	-59	-35	-56	-39	-61	-21	-25	-40	-30	-49	-36	-38	-29	-24	-30	-46	-39	-51
70	-34	-15	-43	-17	-28	-31	-66	-15	-70	-18	-33	-18	-44	-75	-42	-54	-31	-28	-21	-31	-40	-62	-28	-31
65	-36	-48	-33	-18	1	-32	-44	-51	-59	-38	-25	-4	-27	-46	-38	-33	-28	-31	-46	-37	-52	-36	-35	-25
60	-30	-47	-30	-24	-18	-39	-34	-60	-17	-36	-24	-19	-27	-26	-34	-40	-49	-41	-30	-22	-44	-27	-33	-20
55	-27	-36	-29	-27	-5	-36	-24	-31	-10	-18	-21	-20	-39	12	-15	-31	-42	-32	13	-24	-25	-27	-17	-13
50	-31	-22	-29	-35	-28	-13	-17	-22	-33	-29	-27	-14	-46	-28	-45	-36	-55	-56	-34	-39	-30	-38	-26	-14
45	-43	7	-26	-31	-35	-34	-50	-25	-38	-51	-34	-30	-18	-51	-57	-36	-40	-38	-58	-39	-66	-55	-62	-33
40	-44	-48	-54	-60	-38	-52	-73	-39	-39	-41	-36	-44	-30	-31	-42	-55	-52	-51	-66	-59	-68	-45	-52	-41
35	-65	-66	-60	-45	-73	-74	-96	-75	-77	-51	-58	-72	-55	-44	-53	-93	-71	-65	-61	-53	-55	-66	-50	-61
30	-73	-61	-56	-40	-62	-51	-53	-64	-65	-74	-29	-26	-26	-72	-66	-70	-57	-66	-74	-67	-84	-85	-53	-70
25	-72	-71	-76	-59	-51	-65	-70	-85	-55	-75	-55	-48	-38	-36	-56	-65	-63	-58	-50	-54	-76	-72	-75	-74
20	-73	-64	-63	-66	-72	-70	-76	-80	-66	-77	-72	-58	-67	-53	-65	-81	-72	-76	-58	-91	-68	-65	-82	-95
15	-76	-71	-53	-60	-60	-62	-64	-65	-73	-68	-56	-36	-50	-59	-62	-63	-51	-56	-46	-80	-72	-70	-77	-89
10	-71	-77	-85	-69	-89	-66	-53	-55	-59	-62	-54	-42	-47	-64	-77	-71	-77	-65	-60	-64	-60	-80	-75	-65
5	-74	-65	-70	-59	-66	-62	-66	-69	-65	-76	-79	-51	-54	-69	-62	-63	-67	-67	-73	-66	-57	-78	-85	-79
0	-64	-82	-74	-68	-58	-75	-83	-94	-56	-54	-50	-59	-57	-76	-65	-87	-75	-78	-90	-95	-94	-94	-75	-75
-5	-52	-70	-67	-71	-47	-71	-49	-71	-60	-83	-41	-63	-51	-50	-54	-81	-83	-76	-79	-82	-90	-99	-77	-79
-10	-70	-73	-73	-66	-56	-86	-55	-65	-53	-64	-25	-29	-65	-54	-67	-79	-70	-65	-74	-60	-70	-73	-71	-81

TABLE 8 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	1	-6	-5	20	1	60	17	2	11	23	-11	-28	41	40	46	45	45	32	27	11	-4	-31	26	-7
85	-22	-15	-20	20	-22	36	16	8	0	-17	-40	-45	0	0	-20	-3	-1	-3	12	-6	4	5	11	-23
80	2	5	-27	-25	-39	-11	17	23	1	2	14	12	-10	-9	-20	-6	0	-5	7	-15	29	8	-27	-26
75	23	15	-27	1	16	21	29	32	15	16	14	7	-1	29	3	9	22	25	26	32	55	42	18	8
70	-8	17	2	42	34	33	0	-4	-9	-12	-10	-22	-21	-6	-15	14	11	22	12	16	16	12	11	-8
65	11	26	12	-2	13	4	31	31	37	29	14	3	-4	7	10	26	-4	9	6	3	30	25	31	9
60	-4	6	-6	-10	23	0	10	6	6	15	-7	-10	-28	8	7	3	16	3	12	-4	14	-2	-12	-3
55	-6	-5	-6	-3	22	30	12	-21	-20	-25	-5	13	0	-3	1	12	33	17	31	11	25	17	1	6
50	-19	-12	-8	-5	-10	12	-7	9	15	2	3	-1	-2	-30	-5	8	13	21	6	11	17	34	15	-6
45	-14	-12	8	2	-3	4	-19	-14	-16	5	-9	-22	-19	-22	1	9	-5	17	4	2	-9	0	-2	-12
40	8	13	8	-1	-2	-3	-11	-13	-26	-4	0	12	14	9	5	17	3	20	15	14	4	16	18	13
35	-21	-4	-36	-7	-33	-12	-53	-8	-14	-7	-13	0	-13	-12	6	-2	-6	4	-4	10	0	3	-8	-9
30	-15	7	-8	17	-8	14	-42	-15	-21	5	-1	4	3	-17	24	-6	6	9	4	11	2	-3	-9	-18
25	-32	-9	-9	-15	1	-29	-27	-26	-22	-15	-6	-23	7	2	8	-6	4	13	-7	5	-19	-32	-13	-11
20	-21	-4	-15	-43	-13	-32	-27	-33	-25	-33	-22	-33	-14	-5	-4	-16	-7	-7	-21	-8	-15	-22	-20	-5
15	-23	-5	-20	-14	-12	-9	-42	-28	-24	-11	5	-14	-11	-14	-9	-3	-6	-15	-8	3	-3	-15	-15	-8
10	-24	-24	-44	-29	-47	-25	-53	-40	-36	-36	-31	-32	-27	-34	-43	-17	26	-10	-20	-14	-13	-36	-9	-32
5	-19	-14	-27	-28	-36	-13	-22	-22	-13	-32	-11	-17	-10	-25	-37	-16	8	-19	-4	-9	3	-16	-9	-12
0	-31	-31	-1	-15	-7	-2	-40	-36	-29	-14	-6	-25	-45	-34	-31	9	-41	-43	-10	7	1	-2	-9	-14
-5	-29	-22	-30	-25	-44	-28	-41	-24	-47	-29	-41	-41	-55	-39	-28	0	-13	5	-14	-14	-33	-30	-20	-28
-10	-36	-5	-31	-4	-24	-31	-28	-5	-28	-26	-45	-30	-2	-19	-23	-35	-13	8	8	-28	-20	-10	-13	-30

TABLE 9
Corrections Applied to the Bonn 00

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	-99	-99	-99	99	99	99	99	99	0	-78	-99	-99	-99	-99	-99	0	-7	-7	-7	-14	-80	-51	-99	-52
60	-72	42	-85	-99	-99	15	20	47	-45	-64	1	-50	-70	-26	-50	6	8	-34	-19	-34	-70	-56	-99	2
55	-82	-36	-64	-99	-57	-18	-53	-21	-83	-58	-26	-44	-75	-41	-99	-97	-71	-99	-4	-24	-30	-59	-99	-35
50	-58	-59	-31	-35	-41	-39	-48	-57	-63	-72	-43	-58	-83	-48	-42	-38	-77	-99	-25	-33	-53	-58	-58	-52
45	-78	-34	-65	-64	-79	-67	-75	-79	-48	-88	-63	-71	-75	-64	-45	-40	-71	-90	-60	-43	-60	-60	-87	-70
40	-96	-65	-77	-53	-47	-55	-62	-81	-54	-78	-73	-63	-53	-60	-53	-72	-56	-72	-50	-73	-36	-48	-70	-72
35	-76	-81	-45	-51	-60	-58	-72	-79	-72	-79	-70	-75	-56	-69	-48	-80	-57	-82	-57	-60	-32	-60	-64	-88
30	-77	-80	-54	-64	-48	-50	-83	-89	-97	-89	-97	-72	-79	-53	-81	-84	-82	-80	-38	-42	-62	-78	-69	-84
25	-50	-43	-45	-54	-75	-98	-99	-80	-82	-52	-87	-75	-99	-47	-72	-69	-99	-69	-30	-27	-74	-84	-67	-64
20	-54	-52	-57	-21	-67	-57	-97	-73	-99	-66	-71	-70	-89	-55	-66	-64	-73	-60	-41	-56	-46	-75	-53	-63
15	-43	-47	-41	-9	-48	-8	-94	-56	-95	-94	-51	-46	-59	-38	-58	-50	-43	-49	-58	-47	-38	-80	-63	-52
10	-20	-44	-14	-10	-44	-48	-89	-70	-92	-94	-61	-52	-60	-59	-69	-58	-37	-41	-34	-29	-16	-70	-41	-36
5	-36	-34	-24	-22	-73	-44	-30	-44	-53	-56	-52	-42	-42	-31	-67	-67	-56	-36	-37	-29	-13	-12	-9	-19
0	-43	-7	8	-21	-46	-45	-17	-82	-57	-60	-45	-81	-53	-29	-34	-26	-28	-12	-19	-33	-32	-2	-18	-18
-5	-42	-21	-61	-89	-88	-47	-30	-40	-58	-45	-31	-93	-62	-29	-5	-1	-24	-23	-16	-15	-3	25	-45	-47
-10	41	56	20	17	19	29	-16	-32	-65	-28	-11	-10	-15	-18	-2	-4	-23	-25	7	-6	-27	-41	-90	-53

TABLE 9 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	44	54	-99	-99	-99	-99	-99	-99	0	-58	16	16	98	98	99	0	-99	-99	-99	-99	-99	35	60	99
60	42	38	5	-12	-38	-67	-38	-23	-95	-99	-97	-20	48	-29	-4	-48	47	11	2	-5	-14	37	63	99
55	8	20	1	64	45	38	1	26	10	77	8	34	91	32	67	17	43	9	38	37	37	37	44	75
50	21	38	-17	20	14	24	9	24	7	41	5	-2	36	17	45	-4	40	19	8	27	31	49	31	44
45	40	51	26	24	36	34	45	26	12	1	28	26	34	38	57	51	50	63	30	28	25	67	70	66
40	11	-2	-7	9	16	19	1	-6	-2	-11	8	6	5	19	32	18	-20	-5	-4	22	-1	32	27	41
35	0	-10	-7	10	0	2	-37	-39	-29	-4	-23	9	-20	-21	-33	-24	18	-1	39	21	23	0	10	14
30	1	9	2	17	39	31	35	-3	-4	-19	-31	11	13	35	5	21	50	18	30	-19	14	27	42	28
25	2	15	-3	-13	17	17	0	2	-14	-20	-1	-14	9	18	5	2	8	-1	27	-6	17	15	23	20
20	2	-8	16	-6	28	-4	-23	-14	-20	-4	14	-3	11	6	11	6	7	1	29	-7	4	1	24	21
15	34	3	32	11	41	-5	25	12	7	5	3	-5	8	24	37	52	47	26	9	28	-4	47	44	43
10	22	12	25	27	12	26	14	29	-2	16	8	13	21	14	13	11	9	18	11	27	-19	23	26	9
5	25	22	22	17	29	48	14	21	-7	14	21	17	58	30	51	27	22	18	10	6	26	19	34	2
0	11	10	44	-12	32	29	84	18	15	-16	2	-3	16	19	22	58	34	51	25	6	49	66	87	22
-5	3	30	53	56	66	31	78	41	22	-12	-38	-40	-46	25	8	49	-1	34	50	62	38	93	38	89
-10	25	80	17	16	11	4	1	-2	-3	0	-6	13	44	76	30	49	-25	15	50	81	0	24	-58	86

TABLE 10
Corrections Applied to the Bord 50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	-25	24	4	10	-31	-21	-16	-3	-13	-21	-54	-31	0	3	0	-13	-22	-22	-29	-34	-33	-9	-12	-20
30	3	18	3	12	1	1	7	12	8	6	8	13	13	9	1	-6	-9	8	27	18	7	5	7	2
25	15	10	8	1	0	0	-6	7	4	4	21	-1	-5	8	-4	-3	-10	1	0	14	13	12	11	6
20	1	-12	6	-5	2	-12	-15	4	-5	0	16	0	-14	-8	-12	-9	-2	-2	-9	11	16	5	4	-8
15	9	7	15	12	3	-2	2	13	12	15	22	10	12	4	4	6	18	16	18	22	26	21	18	12
10	3	1	-5	-2	-16	-8	-11	-2	11	6	0	-18	4	-2	4	-2	11	6	12	9	14	16	12	8
5	2	-2	-6	-8	2	-1	-4	-8	-2	6	-2	-1	4	2	-5	-1	-3	4	9	12	11	8	7	-4
0	14	6	16	-8	22	-12	16	-7	0	24	28	27	11	5	-8	8	8	24	19	15	5	12	21	10
-5	38	10	14	-2	40	-1	38	17	71	74	32	1	-6	1	7	22	21	34	20	1	-13	33	51	59

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	-8	29	24	50	-8	-31	-25	17	45	46	7	7	21	0	-25	-43	-47	-38	-17	3	0	-48	-51	-22
30	-15	9	6	15	4	-11	3	17	16	18	9	12	1	9	0	-11	-21	-10	-16	-6	-6	-13	-14	-6
25	10	19	21	20	36	12	19	28	25	29	18	3	3	8	15	20	3	19	14	24	12	10	4	11
20	8	0	-3	1	-4	11	11	32	25	0	13	-1	11	9	-1	4	-5	-6	-4	-2	-7	-1	0	-3
15	4	-5	-5	-3	-13	9	-2	3	-4	-3	13	-1	-7	1	1	4	3	-4	-13	-9	-6	-10	2	-10
10	0	-3	-7	-4	0	4	4	-9	9	9	11	2	-6	5	4	2	-6	-2	-3	-2	4	-4	7	-9
5	-11	-3	-15	-20	-6	-13	-5	-27	-9	-23	-15	-12	-5	-6	0	-6	-2	3	-12	-5	-13	-2	0	9
0	-40	-8	-19	-25	-22	-24	-30	-19	-4	-7	-3	-8	-14	-32	-18	-26	-1	11	-16	-2	-35	-5	-15	2
-5	-90	-73	-97	-97	-80	-71	-87	-50	-26	28	10	3	-14	-20	-25	-35	-43	-38	-49	-33	-82	-67	-75	-65

TABLE 11
Corrections Applied to the Sch

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	5	8	-2	-18	3	19	15	26	20	23	13	9	14	8	9	-10	-9	-8	-1	-6	-3	-4	-1	3
85	-6	-8	-17	-28	-3	5	2	10	9	14	7	0	0	-15	-5	-10	-15	-18	-6	-19	-9	-6	1	0
80	-2	-10	4	23	27	20	4	4	5	13	18	8	6	-12	-2	-5	3	-9	6	-5	3	9	19	16
75	18	15	17	16	16	22	17	21	17	24	33	45	33	11	5	-5	7	-3	1	3	4	1	9	15
70	13	15	26	25	24	23	19	22	24	33	21	31	12	16	8	-3	1	-6	-8	3	3	8	5	2
65	6	5	14	14	16	20	24	25	34	39	24	19	-1	4	5	-6	-2	-2	-1	2	-7	12	4	3
60	21	23	19	21	7	16	18	22	18	20	23	17	20	2	6	-2	-12	-5	-13	-12	-6	3	4	6
55	13	11	9	12	1	16	9	23	11	20	17	9	11	-9	4	-4	-8	-12	-11	-5	1	-3	-3	-6
50	12	9	12	-5	-8	1	2	12	3	24	15	6	4	-6	2	1	1	-18	5	4	-10	-7	-8	-3
45	10	8	7	-12	-12	-5	1	18	21	19	6	10	11	7	-3	0	-6	-4	10	20	3	-4	-4	-4
40	8	16	4	-3	-7	-9	-6	1	30	8	6	-1	0	1	-5	-8	-12	-6	-2	-5	-7	-8	-6	-1
35	5	3	-6	-2	-1	2	15	5	28	2	14	3	6	-4	0	-11	-5	-9	8	-4	-1	-7	-4	2
30	8	7	-3	-4	-14	-2	4	-9	9	9	12	0	10	-1	9	-4	-1	4	13	2	7	1	0	5
25	4	-1	0	5	0	1	-2	5	14	14	3	9	2	0	0	4	-4	6	10	8	11	5	7	0
20	9	3	3	1	-5	3	3	7	12	8	5	17	-5	-2	-9	3	1	7	7	15	16	7	6	-8
15	7	9	13	6	-8	-4	1	5	9	6	18	8	2	0	-2	10	5	6	2	19	14	15	3	3
10	-3	1	-6	7	-4	-6	2	11	3	0	3	-3	6	0	2	-1	-5	7	-4	6	2	18	-3	7
5	7	0	0	-8	-6	-18	1	-1	7	4	0	4	2	6	4	8	1	4	6	7	5	7	-4	1
0	5	-2	2	-7	-9	-12	-5	-6	14	5	-1	-3	-8	-1	-3	14	1	6	10	7	15	3	-2	3
-5	-1	5	-14	-2	-12	-4	-7	-6	0	6	1	-2	-3	2	-6	2	-14	5	5	4	4	-1	4	9
-10	-1	13	-12	-12	-15	-4	-21	-10	-5	17	5	5	5	13	-15	5	3	21	12	10	7	12	13	11

TABLE 11 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-22	-39	-38	-28	-23	-44	-1	19	14	-7	20	29	45	23	-8	1	11	10	7	1	9	-36	-56	-12
85	8	-6	19	4	7	-23	2	1	-8	-18	9	11	17	-20	-37	-6	27	40	19	-44	-25	-36	-12	15
80	-26	-21	11	4	8	-4	4	-1	15	-6	15	-14	-1	-4	25	9	10	-7	-11	-6	-5	6	47	6
75	-21	13	22	24	-6	-18	-9	7	11	-35	-4	9	17	9	30	-6	-7	-42	-17	4	2	-1	9	-24
70	2	-15	7	-7	5	-5	-8	-2	8	16	15	33	-8	2	3	-10	-12	-7	17	-14	-16	-20	-7	1
65	1	-13	22	-6	10	1	0	-1	8	21	9	-5	-28	-10	12	-14	-4	-9	10	-13	-19	-7	8	7
60	-1	-3	9	5	-2	6	-2	3	8	9	22	3	2	25	21	11	-1	1	11	6	2	-3	-3	-2
55	9	14	9	10	18	21	7	-1	11	9	6	-2	-15	8	-6	9	-7	0	5	10	8	-8	-16	0
50	-14	-4	-8	3	-1	3	11	4	9	-3	-1	0	11	5	12	-12	-6	-17	12	7	-1	0	10	6
45	-12	10	-14	-1	-14	-6	11	10	8	16	11	1	-11	-2	15	5	2	-17	22	-5	4	3	25	12
40	-1	2	-4	3	4	7	14	-3	6	5	-3	7	1	4	-2	3	5	-6	1	-4	-5	8	4	7
35	8	-7	-4	-17	9	15	26	-5	18	7	-6	-6	13	10	12	-6	-3	5	3	9	-6	-6	1	-11
30	-6	-7	7	2	12	-18	-5	-21	-6	4	4	13	-4	-14	3	5	-4	4	8	9	0	3	7	-22
25	3	13	10	8	4	-10	4	0	9	18	17	6	2	6	-10	4	-8	1	8	8	-12	-8	-2	-2
20	-5	-3	1	-6	1	7	15	3	-2	0	8	-14	8	9	3	6	-5	6	-11	19	-3	7	-10	-7
15	0	-9	16	10	5	15	16	6	3	6	12	7	2	-12	-4	-4	10	4	-14	-2	-7	14	5	-13
10	7	7	-2	11	1	3	7	-3	-11	3	-2	1	-5	5	13	5	-6	8	6	-2	5	-7	2	0
5	1	-3	-9	-1	1	-13	5	-9	-5	4	4	-4	-16	5	5	11	-6	-8	-3	-11	1	-17	-6	-18
0	-5	-18	15	-7	-5	-28	8	7	4	0	-1	-5	-3	2	3	-8	-3	-8	8	5	23	-6	7	-26
-5	0	-34	-6	-32	-2	-26	1	-10	-8	3	-3	2	7	-3	10	-11	-14	-30	15	-6	14	-17	9	-6
-10	-22	-52	0	-9	34	-16	6	-7	0	0	-14	15	17	13	21	20	0	-22	5	-18	-2	-7	-4	-14

TABLE 12
Corrections Applied to the Bonn 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-15	3	8	11	17	7	-4	-24	3	25	35	99	63	54	-24	-45	4	-2	0	0	-34	-74	-99	-31
85	-6	6	17	27	27	17	15	-10	13	-4	-9	16	8	-9	-26	-10	19	1	-15	-24	-49	-45	-90	8
80	11	-41	-15	-22	-1	-8	-13	-20	-5	-1	0	0	-5	-7	-18	-52	-73	-49	-56	-75	-48	-53	-40	-7
75	-2	-47	12	-9	-1	-33	-47	-25	-31	-13	-16	8	-11	-22	-20	-37	-64	-31	21	-16	-15	-51	-29	-46
70	-44	-31	-29	-34	-14	-37	-46	-46	-31	-33	-29	-41	-34	-43	-26	-25	-8	-35	-38	-53	-58	-79	-30	-47
65	-46	-45	-6	-33	-30	-47	-45	-69	-50	-51	-34	-40	-34	-34	-46	-61	-39	-60	-65	-26	-48	-42	-46	-55
60	-37	-42	-13	-57	-27	-73	-45	-80	-59	-65	-81	-28	-57	-49	-65	-65	-19	-57	-73	-82	-72	-61	-88	-57
55	-67	-35	-52	-64	-48	-99	-55	-99	-25	-72	-83	-62	-47	-33	-53	-56	-52	-86	-93	-99	-75	-77	-88	-47
50	-90	-75	-57	-60	-72	-80	-88	-87	-72	-84	-86	-99	-42	-56	-71	-71	-86	-98	-50	-84	-44	-78	-78	-87
45	-99	-99	-99	-99	-97	-20	-86	-96	-99	-99	-94	-88	-13	-40	-43	-61	-99	-99	-90	-89	-35	-85	-99	-99
40	-99	-99	-99	-46	29	99	99	81	-1	-59	-74	-94	-59	-87	-63	-92	-99	-99	-99	-99	-71	-89	-83	-98

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-9	6	-26	8	-45	18	20	24	-16	-26	-18	11	41	32	37	-11	-6	-18	-21	2	11	35	-62	0
85	60	47	1	33	-41	9	3	-1	-38	-25	-35	-10	11	38	53	14	13	-7	3	32	14	-26	-42	29
80	22	16	-16	-30	-38	-21	-10	-26	-17	-13	-32	-38	-69	-20	-8	-1	-46	-21	-9	24	-33	-34	-33	15
75	-30	-5	7	6	15	-2	17	26	12	20	32	-3	-31	5	-27	27	-8	17	-3	27	-9	20	-8	13
70	32	9	-8	0	4	-6	-4	20	-19	-21	11	-9	5	-12	-50	-18	-42	-27	-21	-9	-2	15	8	51
65	15	12	1	6	23	3	11	14	15	18	17	-8	12	-7	13	12	7	15	16	39	22	41	5	14
60	-9	27	8	17	19	6	8	-10	-2	3	-14	-2	28	12	10	-6	-7	5	23	22	-14	11	-23	-21
55	10	28	-14	60	45	10	10	7	13	21	-9	-4	16	-5	11	-11	17	-12	42	28	-7	40	38	53
50	51	67	-29	38	41	42	31	24	13	37	26	41	-1	15	35	34	39	31	51	57	22	76	18	74
45	69	78	-22	-32	-9	9	38	48	61	10	28	52	19	60	57	53	47	65	33	69	26	99	-7	77
40	99	99	95	61	51	28	99	99	99	99	99	96	70	99	63	73	73	80	46	99	99	99	99	99

TABLE 13
Corrections Applied to the W2-50

	Right Ascension																							
dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	11	-1	-11	1	4	23	6	22	7	-10	-34	-55	-4	5	20	0	1	6	2	2	12	30	58	26
85	11	12	19	15	11	16	-8	4	-5	5	5	-13	10	10	9	4	5	1	2	15	22	15	30	4
80	-9	-11	-2	-15	-8	-3	-17	-14	-32	-20	-6	-26	2	-5	-9	-6	-3	-7	-7	-2	5	8	1	-9
75	-15	-13	-24	-10	-11	-13	-9	-7	-23	-15	-10	-18	-3	-12	-21	-13	-19	-12	-12	-16	-3	21	7	0
70	-2	6	-16	2	2	3	6	-2	-16	-3	-15	8	-6	-9	-12	-2	-6	2	-7	4	5	23	8	5
65	-3	-15	-30	-25	-13	2	-4	-2	-11	-1	-31	-8	-8	-18	-2	-13	-7	-8	-23	-14	-4	5	16	3
60	-6	-16	-19	-5	-7	-9	-6	-12	-18	-13	-26	-10	-2	-21	-14	-25	-4	-2	-9	-8	-1	-4	9	10
55	-18	-18	-17	-20	-21	-27	-17	-25	-32	-28	-28	-4	-1	-16	-17	-23	-16	-15	-13	-12	-5	-3	-1	-7
50	-4	-14	-14	-36	-25	-29	-5	-10	-21	-29	-31	-18	-19	-14	-15	-22	-13	-12	-8	-18	-31	-5	-12	-14
45	-1	-19	-5	-24	-12	-14	-6	-23	-18	-36	-16	0	-6	-9	-7	-9	-17	-1	-14	7	-21	5	-43	-25
40	-18	-25	-25	-30	-21	-24	-34	-42	-28	-29	-28	-22	-23	-32	-14	-11	-29	-11	-29	-17	-21	-27	-42	-19
35	-17	-26	-33	-42	-34	-35	-46	-43	-18	-25	-53	-31	-41	-33	-42	-43	-35	-15	-18	-27	-15	-22	-23	-3
30	-11	-34	-36	-47	-18	-23	-12	-21	-19	-19	-17	11	-15	-14	-37	-17	-16	-13	-24	-19	-8	-22	-22	-18
25	-15	-18	-27	-46	-19	-32	-19	-28	-28	-28	-27	-19	-38	-45	-37	-14	-13	-12	-25	-18	-23	-18	-24	-18
20	-30	-33	-33	-41	-28	-28	-22	-28	-26	-25	-33	-29	-14	-47	-14	-19	-25	-26	-35	-31	-29	-22	-35	-30
15	-37	-37	-30	-15	-26	-27	-29	-32	-34	-38	-62	-47	-29	-53	-22	-27	-15	-21	-29	-34	-22	-28	-38	-36
10	-19	-35	-40	-42	-41	-52	-33	-39	-31	-33	-44	-37	-34	-34	-31	-31	-12	-31	-31	-39	-35	-31	-38	-34
5	-40	-52	-50	-44	-43	-52	-37	-37	-40	-32	-47	-36	-48	-42	-40	-44	-26	-43	-25	-43	-41	-32	-33	-45
0	-46	-52	-61	-66	-64	-46	-44	-46	-69	-46	-55	-36	-40	-41	-28	-27	-32	-33	-35	-39	-53	-53	-43	-45
-5	-38	-27	-27	-52	-48	-51	-41	-47	-47	-46	-53	-62	-46	-50	-52	-40	-37	-37	-53	-42	-39	-48	-46	-42
-10	-64	-46	-45	-47	-44	-56	-44	-51	-24	-36	-45	-51	-45	-28	-47	-37	-31	-29	-29	-42	-45	-64	-54	-51

TABLE 13 CONTINUED

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-27	-25	-23	-14	-8	-47	-4	-10	-19	-51	-34	-13	8	-7	13	-15	-9	-2	-1	0	-8	-28	-54	-28
85	33	-6	-10	-6	8	-20	10	0	-5	-16	-12	12	19	16	20	4	3	8	3	-3	8	10	0	20
80	-42	-41	-21	-1	-2	-3	-2	4	-11	-6	18	19	22	7	23	6	-3	8	6	-6	27	-4	5	-10
75	-38	-18	-5	-2	-26	-26	-21	12	7	-2	-22	-22	-11	-8	38	-4	3	0	8	4	11	-17	2	1
70	-13	5	-2	-8	-8	-5	-3	-12	-17	-2	-26	-10	-12	14	33	10	-5	11	1	8	-3	7	2	5
65	-20	1	-17	-21	-1	-2	16	6	-3	14	12	4	-6	10	12	7	7	21	0	-6	-12	20	1	9
60	-20	1	-11	-9	0	-22	-23	-7	1	1	-9	-5	-5	15	4	-8	12	2	2	5	-3	11	-14	-11
55	-43	-19	-17	-2	-13	-15	-11	-21	-8	-17	-22	-6	-7	20	-1	-8	8	-13	4	-17	-19	-21	-31	-42
50	-12	-4	-13	6	-33	-1	8	-11	-7	-23	-12	7	1	4	-10	6	13	4	36	-3	13	11	7	-11
45	-32	-22	-30	11	-13	-21	13	-15	-3	-1	-29	20	-2	9	13	19	30	-25	27	-5	40	14	-7	-17
40	7	5	-4	1	5	-22	25	-10	28	4	15	16	-1	16	7	25	30	18	23	6	7	4	-21	4
35	-10	-10	-20	0	-12	-3	33	-8	35	11	18	10	22	14	5	-6	12	31	13	14	-6	-4	-11	-11
30	9	7	0	29	11	9	-17	-10	14	59	-19	6	12	6	35	20	31	41	9	6	24	15	31	-1
25	33	19	22	24	25	37	28	6	25	26	7	17	29	22	37	24	48	44	27	22	5	22	11	13
20	14	5	9	14	14	5	22	2	3	-2	20	25	4	27	32	40	50	31	37	-13	2	12	16	10
15	8	-6	-14	8	19	-7	-6	2	7	46	24	28	11	35	29	20	3	15	34	4	16	-6	11	2
10	19	-11	0	14	11	37	16	17	25	33	4	16	19	51	32	39	38	39	14	11	24	2	22	-9
5	15	-5	21	7	21	44	22	0	7	5	23	21	18	15	5	29	31	35	8	20	1	-8	14	4
0	-7	6	4	9	-7	-27	-11	5	30	23	16	5	27	17	12	28	7	18	31	25	3	-2	13	21
-5	8	11	-10	15	21	40	23	2	17	28	11	-24	29	19	17	25	12	16	14	-13	6	-1	15	-12
-10	20	32	14	7	15	19	9	-24	-17	3	15	-22	23	11	16	26	1	13	-1	31	51	41	34	2

TABLE 14
Corrections Applied to the W3-50

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	6	8	0	13	6	12	4	18	1	6	-15	-23	14	12	11	-17	-1	11	12	-1	-5	2	24	20
85	1	15	27	26	14	12	1	15	-8	3	-14	-20	-2	2	-5	-12	-23	-8	-2	-10	-14	-10	12	5
80	-19	-9	14	6	9	10	2	-2	-20	-3	-9	-3	-7	1	12	4	-6	-27	-3	-4	4	-2	10	-12
75	-18	-10	14	-5	14	-4	-2	-31	-33	-16	-14	25	8	-3	-19	-4	3	-25	-11	-40	-9	-2	-7	-32
70	15	26	29	-2	5	1	22	11	13	20	-5	1	-12	-1	-32	-12	-26	1	-22	9	1	12	6	14
65	0	1	-27	-9	-25	-14	-4	-10	-11	-34	4	-8	-14	-16	-21	-32	-38	21	-35	3	-13	26	7	8
60	6	-24	-4	22	42	13	6	-8	-7	-38	0	0	1	15	-9	-18	-28	9	-23	-44	-6	-4	2	-17
55	18	0	6	-2	4	14	-4	-1	-5	4	-9	6	5	28	-1	7	-25	-8	-14	-8	8	11	17	10
50	10	1	3	2	-3	13	4	-5	-7	1	5	-2	0	7	1	6	-6	1	-11	-5	-25	3	-3	5
45	17	8	12	6	13	16	16	5	7	-4	9	5	8	8	-6	6	-6	12	-2	-2	-4	13	8	11
40	12	9	9	1	10	-6	4	3	9	-5	1	-4	-3	-4	-6	-2	1	13	10	-4	-4	0	1	5
35	11	4	0	-10	3	-7	4	-13	5	-6	3	-7	-4	-12	-12	-18	-18	-22	-19	-28	-9	-14	1	-4
30	18	5	1	5	19	10	17	-17	10	-7	5	8	14	-4	-5	3	-2	6	26	1	2	-5	10	4
25	29	24	7	15	14	13	18	7	15	10	6	24	10	-6	11	12	19	8	34	12	7	-4	2	17
20	5	24	5	6	15	10	12	11	18	9	11	11	9	-13	16	11	19	-11	-7	-9	-1	-2	0	14
15	4	17	-12	22	17	0	7	5	7	8	11	8	7	-7	10	7	-1	11	7	9	1	12	11	25
10	12	17	-3	5	-1	6	9	-7	9	7	1	-3	-6	4	8	-2	4	-2	0	-8	-7	-7	0	5
5	-1	-14	-3	-5	-10	-14	6	-23	-4	0	1	-4	-4	0	-1	4	1	-11	-6	-13	-1	11	1	-15
0	5	-18	7	3	-15	-32	4	-14	-12	-3	8	9	14	7	5	9	-3	-7	-13	-26	-6	-10	-5	-10
-5	-17	9	-18	-4	-12	-17	2	-9	-7	-6	-12	-27	8	-4	-8	-7	-7	-6	-17	-30	3	0	-29	-15
-10	-21	15	-33	-18	-11	-20	-12	-25	-9	6	-9	-7	1	3	-18	-6	-21	-12	-8	-10	7	-10	-47	-3

TABLE 14 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-7	-12	-8	-11	-2	-44	2	11	12	-35	-30	-32	5	9	32	36	13	-3	-13	-28	-49	-46	-38	-21
85	27	2	-11	-6	12	-26	4	-6	1	-32	-2	-15	15	6	11	18	24	14	4	-9	-24	17	2	11
80	-5	20	-4	10	5	-11	-15	-14	17	-3	18	-14	14	-20	-31	-24	-27	-3	-32	6	-13	21	6	7
75	-19	-2	-23	-26	-11	-2	-22	3	0	11	-16	4	-20	-25	0	-11	-2	4	-12	15	-7	-5	19	9
70	-9	0	10	-41	-13	-10	-10	-24	-61	-4	-7	38	-27	14	26	26	-1	4	-10	1	18	3	12	-53
65	-15	17	15	-5	-31	17	14	7	10	-13	29	-17	-56	-7	-2	-3	-44	2	-16	-17	29	-9	-3	-48
60	-18	-3	-32	-28	-24	11	-17	-11	6	-23	5	-26	-10	35	13	-3	-21	23	5	-19	-21	3	-11	4
55	-26	-21	-22	-9	-9	-6	4	-20	-19	-11	-11	-36	-33	-8	-23	-2	-13	34	-17	-6	-53	6	-13	-9
50	-16	-22	-10	-15	-40	-6	-7	-14	-30	-29	-20	-21	-13	-8	-4	21	13	20	-18	-3	-13	-6	-10	-10
45	-12	-20	-11	-9	-14	2	-6	-5	-5	-9	-8	-14	-10	0	4	6	-5	-8	-14	2	0	-6	-15	-9
40	-6	-10	-16	2	2	-14	-13	-21	0	-9	-10	-24	-12	1	9	1	0	3	3	-17	-11	4	0	2
35	2	4	6	3	1	0	3	-17	-6	-6	2	-3	5	12	12	9	0	6	13	-3	0	3	-1	1
30	8	22	13	6	0	11	-3	-10	1	-9	-7	-22	-13	13	21	34	14	-12	11	8	30	2	-11	3
25	24	24	13	11	17	9	11	7	4	15	12	25	-9	22	25	16	37	14	26	-6	0	13	13	25
20	6	7	7	13	6	-10	-10	-8	-2	-18	-9	4	-5	35	26	13	4	0	0	-7	0	15	7	1
15	-7	-8	-5	18	-7	-5	-14	-29	-11	-35	-2	7	-4	-10	-2	-7	3	-3	-5	1	-13	-5	-4	9
10	0	-1	6	8	-4	2	14	-1	18	5	11	7	6	1	4	24	33	14	21	9	-3	5	8	13
5	-9	-1	9	-17	-3	-23	-3	-9	1	-10	-12	6	-26	6	-9	12	19	-5	17	2	-15	7	7	18
0	-20	-17	13	-1	18	-3	-17	-16	9	-9	-14	-19	-39	-5	1	4	8	-13	8	-27	4	13	1	-9
-5	-3	-21	-26	-29	-5	1	8	-22	-6	-42	-4	-15	7	-6	14	4	25	-9	15	-12	20	3	0	-7
-10	21	-4	-4	-19	2	-8	-19	-43	-25	-17	5	-3	-25	-27	-6	-5	7	-30	-14	24	53	-2	14	0

TABLE 15
Corrections Applied to the GCH 1-50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	-8	12	6	-15	-32	4	-6	-5	-23	-16	5	-22	-13	-15	-9	-34	3	-22	12	6	7	6	-3	-11
20	8	6	-6	-3	0	-18	-12	-28	-25	-18	-14	-29	-43	-24	-10	-18	0	-14	-17	-31	-20	-7	17	3
15	14	-16	14	11	-9	13	19	7	-19	-12	-17	2	-8	0	4	4	11	11	3	-2	3	23	28	-2
10	44	16	28	12	-9	7	11	0	2	-7	7	6	0	-6	9	10	15	23	30	0	17	24	22	8
5	26	17	26	21	12	37	17	11	-8	6	9	-9	10	11	26	7	3	13	22	16	25	25	33	28
0	19	-7	32	31	20	26	13	10	-1	16	7	17	-6	15	26	7	14	9	-4	10	3	17	52	23
-5	0	0	0	0	80	99	99	99	59	26	77	86	38	15	99	10	-18	99	99	99	99	99	0	0

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	42	16	28	25	17	39	-4	1	15	6	50	28	36	35	3	9	20	32	38	38	46	41	35	30
20	36	37	17	26	32	47	40	46	55	47	27	35	34	25	25	49	38	30	34	46	42	47	36	32
15	25	23	5	27	22	24	23	37	30	43	39	29	25	24	22	22	35	38	28	48	30	32	22	24
10	-2	9	-5	12	0	1	-7	9	28	11	14	12	8	11	-13	13	17	14	18	38	25	35	30	17
5	33	26	9	23	21	46	30	34	46	25	29	-5	12	2	-14	6	8	9	31	28	26	22	13	20
0	19	27	-2	50	48	23	47	54	40	54	43	31	22	25	33	42	17	6	37	78	50	59	71	40
-5	0	0	0	0	-6	21	44	-99	-99	-99	-99	-89	-99	-99	-98	-99	-99	-99	-99	-54	-54	-54	0	0

TABLE 16
Corrections Applied to the Cape02 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	-99	17	24	46	32	-9	-40	-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	16	-99	-39	-68	-59	-76	-80	-99	-99	-99	-70	-62	0	0	0	0	0	0	0	0	0	0	0	0
25	-76	-62	-74	-73	-80	-89	-85	-99	-91	-99	-99	-99	-99	0	0	0	0	0	0	0	0	0	0	99
20	-55	-37	-55	-54	-88	-87	-83	-95	-91	-99	-86	-99	-99	-99	0	0	0	0	0	0	0	0	0	-28
15	-58	-47	-62	-55	-78	-69	-75	-99	-99	-99	-77	-95	-83	-99	84	0	0	0	0	0	0	0	-99	-38
10	-61	-48	-68	-67	-87	-68	-73	-99	-99	-99	-72	-70	-72	-95	-99	-99	0	0	0	0	0	99	-93	-47
5	-45	-46	-50	-51	-54	-65	-99	-99	-99	-98	-77	-79	-81	-85	-90	-80	-99	0	0	0	-99	-29	-40	-42
0	-38	-68	-66	-99	-77	-99	-28	-57	-44	-99	-82	-86	-63	-69	-60	-66	-37	0	0	0	99	-41	-24	-41
-5	-49	-59	-68	-99	-99	-99	-28	-28	99	-99	-47	-65	-44	-77	-42	-59	93	0	0	0	99	-52	-43	-63

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	99	99	99	99	17	-21	-99	-85	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	-99	-12	73	99	99	95	31	15	-38	-20	-43	99	0	0	0	0	0	0	0	0	0	0	0	0
25	-59	-7	6	21	16	15	-2	2	-13	-9	0	20	99	0	0	0	0	0	0	0	0	0	0	-99
20	-17	8	12	27	19	11	3	13	26	7	19	31	75	99	0	0	0	0	0	0	0	0	0	7
15	10	15	29	33	40	45	60	40	36	8	18	14	24	16	42	0	0	0	0	0	0	0	-63	-10
10	14	2	27	9	27	6	93	11	16	11	19	10	9	-1	0	99	0	0	0	0	0	-99	46	-8
5	13	18	34	31	41	-9	-42	25	42	43	36	31	15	8	-3	14	70	0	0	0	99	-30	-1	1
0	-1	12	6	24	12	43	12	16	95	25	19	2	3	-6	6	4	85	0	0	0	-99	-42	-20	-4
-5	2	17	0	11	5	31	12	12	99	1	-1	-8	-3	-8	15	21	61	0	0	0	-99	-55	-34	0

TABLE 17
Corrections Applied to the Nice 10

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	-99	-99	99	99	6	-53	-99	-20	99	99	-35	-99	11	-18	-99	-99	30	-99	-99	-99	-99	-45	-99	30
15	-55	-46	-67	-89	-59	-19	-90	-97	-94	-82	-81	-84	-68	-85	-60	-18	-99	-80	-88	-78	-32	-53	-68	-25
10	-99	-85	-96	-35	-42	-58	-96	-86	-69	-73	-90	-99	-75	-64	-85	-78	-51	-43	-93	-64	-55	-84	-69	-75
5	-32	-85	-64	-68	-10	-56	-88	-79	-97	-99	-99	-86	-99	-99	-99	-99	-99	-99	-99	-98	-50	-90	-78	-50
0	0	99	36	-99	-99	-79	-51	-99	-99	-99	-99	-99	-99	-99	-44	99	-99	-99	-99	-99	-99	-51	-87	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	57	77	99	99	-99	-99	-99	-99	99	51	-84	99	99	99	-46	-99	-99	-80	77	99	99	99	99	99
15	88	77	30	-29	29	24	-2	15	28	85	35	48	34	99	96	74	98	49	41	78	-2	32	53	53
10	47	42	28	49	46	43	18	40	-9	3	37	45	44	90	93	54	44	13	33	46	35	51	10	19
5	99	79	-59	29	42	82	28	41	46	69	5	49	51	41	90	79	46	42	14	40	57	87	43	18
0	0	-99	-99	-19	99	99	99	-5	-99	-99	-74	99	99	99	59	-84	99	99	99	-28	99	56	-99	-99

TABLE 18

Corrections Applied to the Nice 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	-99	-99	-8	6	-12	-61	-99	-99	-99	-99	-99	-99	-99	-99	-99	-95	-79	-88	-99	2	23	-15	-70	5
5	-50	-52	-60	-51	-56	-63	-80	-99	-88	-86	-82	-82	-99	-48	-54	-98	-76	-75	-99	-53	-27	-51	-85	-40
0	-55	-54	-68	-50	-94	-96	-81	-99	-99	-62	-86	-89	-82	-75	-66	-75	-76	-70	-73	-71	-69	-56	-56	-53
-5	-68	13	-63	-90	-69	-89	-97	-76	-91	-99	-99	-92	-99	-90	-62	-83	-99	-60	-68	-74	-71	-77	-84	-92

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	21	72	11	-6	47	99	-16	-99	-64	99	99	99	99	99	-99	-95	-99	-56	99	-99	-99	-98	56	-4
5	40	13	8	39	36	68	43	11	32	31	56	60	62	42	33	80	49	52	66	67	63	34	64	54
0	1	23	13	16	3	4	4	44	51	18	33	58	18	25	79	71	50	38	10	24	48	64	28	46
-5	-13	29	3	44	36	65	45	2	57	11	39	4	55	47	29	64	23	55	77	37	61	38	46	0

TABLE 19

Corrections Applied to the GCH Z 10

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	14	2	-39	-99	5	45	-23	-81	6	2	-55	-67	-95	-66	7	24	-39	-71	-12	-34	-32	4	-19	-18
30	-63	-41	-39	-58	-58	-59	-34	-74	-67	-84	-84	-46	-47	-91	-99	-99	-79	-94	-73	-83	-72	-76	-82	-48
25	-73	-67	-74	-52	-74	-64	-76	-87	-64	-66	-60	-52	-81	-69	-53	-76	-89	-72	-50	-71	-89	-65	-74	-55
20	40	-43	-99	-85	-70	-32	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-57	-99	-99	-99	-17	61	38	55

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	81	98	19	-14	29	12	2	50	6	20	90	40	37	22	10	-20	18	8	-37	-19	-14	-30	-39	0
30	-32	-17	-15	-31	-38	-22	-39	-18	-18	-20	-21	-27	-18	-15	-23	-39	-12	1	-29	-40	-32	-32	-9	-25
25	-13	-19	-18	-28	-16	-30	-9	-13	-7	-3	-1	-3	-15	-28	-15	-10	-20	-22	-44	-27	-32	-37	-4	-17
20	24	-3	32	14	9	-27	20	-6	23	5	9	6	76	18	-19	8	-11	28	7	-21	-74	-74	-69	-45

TABLE 20

Corrections Applied to the Paris 90

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	-46	-99	44	-99	-99	-99	-99	0	0	0	0	0	0	0	0	0	0	0	0	0	-99	-99	-99	99
55	-18	52	99	99	32	42	99	-80	-21	47	90	99	-62	-40	99	-99	11	99	99	81	99	99	99	68
50	27	99	99	99	-99	-99	-5	8	23	48	99	65	-99	11	40	84	-26	6	-10	-27	99	19	8	31
45	54	83	-68	99	28	-99	-99	-94	-99	-74	14	-19	-71	15	-16	68	-4	21	-55	59	99	31	66	99
40	7	8	-13	-57	-99	-99	-99	-63	37	-44	-18	65	-20	-46	-85	-50	-60	-67	-14	-43	-32	-21	-49	-28
35	-99	-28	-3	32	-41	-95	-93	-99	-99	-43	-32	-53	-79	4	-99	-99	-93	-79	-17	-32	2	99	87	-79
30	-9	5	-4	-77	-99	-99	-99	-86	-99	-99	-16	-5	-99	-99	2	-67	-99	-69	-57	-45	-31	46	30	-97
25	59	99	-13	-53	-99	-99	-99	-99	-99	-99	-92	-99	-99	-99	-99	-99	-99	-60	-24	-25	-47	-80	-41	11
20	-39	-25	-61	54	-27	-99	-99	-99	-99	-99	-87	-31	-21	4	-99	-99	-92	-67	-99	-65	-23	-99	-51	-9
15	-40	-42	-49	-14	-99	-99	-99	-99	-99	-99	-60	-99	-99	-99	-99	-62	-22	-8	-55	-99	-99	-89	40	-6
10	-83	-15	-23	-99	-32	-8	-90	-99	-99	-99	-89	-63	-99	-89	-99	-99	-99	-84	-42	14	-17	-65	2	-51
5	-6	-38	-86	-92	-99	-99	-99	-99	-88	-22	-26	-77	-41	-99	-24	8	-14	33	-37	72	37	76	83	-99
0	7	99	12	-52	-99	-99	-99	-97	-99	-99	-99	-99	-77	-99	-29	-99	-99	-17	-64	-64	-17	-99	21	87
-5	35	99	39	-6	-68	-69	-99	-99	-99	-99	-57	-72	-16	-10	-77	-99	20	-88	-99	-29	27	-49	-3	99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	-99	-99	47	99	99	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0	99	99	99	-99
55	-20	-61	99	99	-37	15	-31	-57	71	32	60	99	14	-99	99	60	64	8	5	43	30	-64	-99	-67
50	25	-9	14	58	-5	70	21	-57	33	49	31	37	-17	-42	-4	42	-39	-92	-77	-70	-46	-33	-20	-8
45	25	44	27	11	-1	96	-32	8	66	99	27	-1	10	90	6	2	-7	-40	-46	-90	-70	-59	-34	-12
40	57	51	7	-62	-70	-6	-22	14	31	4	9	40	42	89	1	-14	-99	-99	-99	-52	-86	-87	-22	-40
35	-44	-49	-44	33	39	-14	-40	43	31	20	35	33	-12	-3	27	-20	-53	-50	-45	-28	0	-10	-28	-99
30	-57	-35	79	14	19	55	35	49	32	55	15	31	57	-5	41	-7	-42	-43	-28	-27	-21	11	-32	-24
25	24	-36	19	29	84	37	33	30	62	47	14	-67	8	99	58	-15	-29	-32	-34	-71	-40	-8	-30	24
20	8	52	15	47	44	59	77	27	-1	52	65	-20	-21	85	55	-3	-8	-41	-99	-22	37	54	-26	-8
15	-31	-27	-1	48	25	57	88	39	62	45	37	94	64	43	27	-14	14	-3	-48	-59	3	-28	-54	-21
10	-1	-4	-14	30	-4	36	99	78	5	35	45	7	55	43	25	25	-16	-38	-15	-18	-12	-26	-26	35
5	-22	25	45	-45	27	73	66	-15	33	46	51	53	29	68	44	-37	-7	5	2	-65	-6	-51	-99	-93
0	26	-43	49	-5	57	59	44	99	99	83	65	84	20	36	57	-16	0	-77	-76	-8	-56	-18	-38	-22
-5	-59	-11	99	19	-34	19	93	99	51	32	69	18	-1	56	44	2	-19	-99	-58	-49	-35	-2	-16	-99

TABLE 21

Corrections Applied to the Paris 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	2	75	57	-14	-99	-90	-47	-12	4	-68	-99	-99	-96	-99	-99	-99	-51	30	55	0	-71	-99	-99	-54
25	-62	-48	-57	-83	-99	-99	-99	-99	-99	-99	-99	-99	-67	-81	-99	-99	-99	-84	-89	-87	-94	-99	-99	-75
20	-81	-94	-82	-99	-99	-99	-99	-99	-99	-99	-99	-99	-88	-99	-99	-99	-99	-99	-99	-99	-87	-82	-82	-81
15	-88	-99	-72	-92	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-92	-93	-88	-87	-79	-38	-49	-73	-99
10	-85	-99	-93	-99	-99	-99	-97	-99	-99	-99	-99	-99	-99	-99	-63	-43	-33	-28	19	11	72	30	-23	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	-4	-37	12	27	19	-4	-17	18	31	22	0	17	-4	8	12	26	48	44	53	54	31	-2	15	3
25	28	4	32	31	18	3	-6	10	23	32	5	6	-13	3	-2	16	25	31	20	30	20	19	37	20
20	12	0	12	20	11	5	-5	-6	3	18	5	-4	-10	0	1	12	6	13	-5	22	18	22	25	4
15	-25	-34	-38	-5	-12	-20	-38	-40	-23	-6	-10	-27	-30	-27	-9	-11	-22	-12	-31	10	6	0	-7	-27
10	-72	-99	-99	-99	-96	-99	-99	-83	-25	-14	-29	-75	-99	-99	-91	-90	-62	-23	-38	-14	-26	-56	-78	-78

TABLE 22
Corrections Applied to the GCH 2-25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	-4	-7	18	29	-10	11	4	7	11	4	-13	13	-17	-33	-38	-8	24	-23	-23	-45	-29	1	25	-5
60	-8	-15	-27	14	0	-9	-17	0	-8	-5	-13	-17	-14	1	0	-13	-15	-19	-21	-19	-12	-17	-4	-8
55	2	-13	-12	-12	-10	-24	-21	-19	-31	-28	-8	-19	-21	-24	-16	-18	-14	-26	-10	-27	-41	4	-13	-21
50	-33	-23	0	-9	-12	-30	1	0	-18	-18	-19	-19	-42	-23	-25	-11	-8	-46	-23	-20	-20	-6	-5	-11
45	-6	-8	-15	-7	-25	-9	-23	-7	-2	5	-18	-19	-33	-39	-18	-32	-15	-11	-27	-13	-37	-33	-24	-10
40	-22	-28	-27	-31	-20	-9	-34	-18	-4	-21	-28	-8	-33	-27	-28	-20	-29	-30	-31	-24	-27	-24	-13	-2
35	-33	-28	-15	-5	-22	-12	-18	-39	-35	-8	-22	-23	-31	-13	-20	-24	-43	-39	-38	-21	-29	-8	-26	-29
30	12	-81	-42	-15	-34	-14	2	-34	-58	-50	-28	-18	-44	-16	-15	-33	-54	-36	-24	-41	-67	-48	-46	45

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	39	78	70	61	78	40	60	85	51	6	30	11	5	3	-4	48	26	3	3	27	41	28	60	72
60	30	29	43	32	20	51	38	34	32	39	11	18	33	27	3	9	-3	-9	-11	-14	10	15	14	17
55	28	54	34	24	32	27	40	15	16	39	40	26	31	29	21	16	3	8	7	-2	4	11	28	30
50	8	7	-13	20	14	21	16	7	33	20	0	9	12	8	-2	-7	15	0	-9	-22	-8	14	11	5
45	7	32	42	25	18	16	13	24	32	8	-7	-13	-8	-2	-7	5	-13	-18	-8	-24	-5	-9	9	11
40	27	34	31	15	19	27	12	37	33	11	29	4	25	24	15	11	8	17	-12	-1	-1	25	30	38
35	13	25	4	-4	10	12	-7	5	4	3	6	20	1	0	-4	2	-9	4	-21	-10	22	11	6	8
30	-5	24	46	6	-13	-1	20	8	-8	-19	-7	13	-31	-16	6	3	-12	2	-10	-27	24	1	35	37

TABLE 23
Corrections Applied to the Berl 20

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
45	-84	99	79	-99	-99	-78	71	20	-99	63	84	-82	-88	-88	-38	99	99	37	-19	-99	-99	-99	-99	-99
40	-99	-79	-73	-68	-79	-99	-86	-81	-99	-84	-73	-64	-93	-99	-85	-84	-96	-95	-87	-98	-62	-91	-79	-99
35	-99	-99	-99	-92	-84	-99	-99	-99	-99	-99	-99	-99	-94	-99	-99	-99	-99	-99	-99	-86	-99	-99	-99	-99
30	-96	-50	-90	-99	-99	-99	-83	-99	-99	-99	-86	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-71	-99	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
45	14	-99	-99	66	99	99	32	89	-99	-99	-99	99	99	-74	-99	-14	37	-24	99	99	42	99	99	99
40	22	-20	-32	-40	-16	-29	-35	26	-63	-65	-23	-4	-12	5	-31	20	18	0	9	6	27	28	17	47
35	-21	-20	-3	13	-2	-11	-57	-19	-29	2	-3	-11	-24	5	-13	-25	-12	21	0	-16	-8	2	-4	-8
30	89	43	61	26	8	34	67	76	67	32	-14	-9	25	47	-25	42	35	81	85	35	52	6	75	89

TABLE 24
Corrections Applied to the GCH 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	99	10	-13	83	58	71	94	54	50	54	69	99	46	35	-32	-34	-28	4	18	-12	-62	-65	-27	26
85	12	-4	-18	3	-24	-9	-14	16	13	6	-24	11	-4	-15	-23	-15	-1	43	2	-64	-50	-45	-32	-45
80	-56	-54	-57	-35	-28	-7	-40	-61	-31	-20	-40	-55	-26	-13	-52	-45	-50	-42	-53	-54	-65	-29	-72	-76
75	-11	-34	-64	-31	-9	-1	-26	-22	-39	-47	-34	-55	-31	-51	-88	-65	-25	-31	-52	-62	-59	-44	-74	-66
70	-48	-38	-32	-41	-60	-49	-20	-35	-39	-33	-51	-46	-61	-85	-63	-64	-51	-72	-48	-54	-73	-78	-66	-38
65	-99	-97	-87	-81	-63	-76	-86	-69	-83	-73	-92	-99	-90	-99	-75	-92	-89	-92	-99	-87	-94	-99	-99	-99
60	-27	-99	-99	-89	-99	-99	-99	-99	-99	-99	56	-55	-99	-99	-64	-99	-99	-99	-99	-99	-99	-99	-99	-8

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-7	-15	-44	-28	-37	12	30	58	21	12	7	-42	-10	34	28	26	20	-19	21	-6	5	13	28	22
85	22	-19	-19	-1	12	21	-15	1	9	-25	-3	-29	-41	20	31	13	-28	3	9	-6	0	-9	-20	-12
80	5	-14	-5	-44	-61	-25	11	-3	-19	-2	-21	-9	-13	-23	-26	-23	-24	-43	-24	3	0	-34	-27	-20
75	44	5	-4	17	9	5	7	-10	-4	-11	3	-33	-13	-14	-57	-33	3	-12	1	27	12	-14	10	40
70	14	38	43	29	40	28	41	16	-3	-62	-24	-14	11	30	-2	16	21	-5	0	-6	30	74	41	23
65	10	11	-18	6	-13	7	18	-5	10	33	35	-16	-10	5	-1	15	23	2	1	3	29	54	28	-7
60	-35	63	99	52	26	45	25	-40	-15	21	32	-61	-54	20	48	-31	-47	40	3	-4	99	99	99	35

TABLE 25
Corrections Applied to the Toul3 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
15	-42	-71	-97	-99	-99	-99	-99	-99	-99	-99	-54	-99	-99	-83	-93	-99	-88	-99	-99	-99	-98	-90	-65	-1
10	-69	-82	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-74	-82	-74
5	-82	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-95
0	-99	-59	-69	-61	-87	-99	-99	-99	-99	-99	-99	-84	-99	-99	-57	-41	-99	-99	-99	-99	-99	-99	-99	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
15	-50	16	-14	-51	-62	-2	25	0	6	-51	-31	-28	-67	-23	6	8	10	11	-34	-20	-34	-28	-55	-74
10	-7	2	14	21	20	6	-2	-21	2	-5	-7	-8	-29	4	9	4	22	24	10	-1	-9	14	-1	-11
5	7	4	9	1	20	11	4	5	-5	-12	-5	-21	-4	-6	-12	25	15	1	2	-10	-11	-6	-5	4
0	-39	-28	-23	-6	27	58	44	39	17	15	-6	-27	-9	0	-19	29	39	40	45	36	70	31	-6	8

TABLE 26
Corrections Applied to the Cape 2-25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	0	0	65	1	-94	-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	-99	-18	-1	-7	6	44	-36	-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	-99	-52	-4	5	-9	-17	13	0	-13	6	99	0	0	0	0	0	0	0	0	0	0	0	0
20	99	83	19	19	10	-1	-13	5	14	-9	11	48	29	0	0	0	0	0	0	0	0	0	0	0
15	41	17	-2	4	-8	20	26	-21	10	-4	6	-8	-45	0	0	0	0	0	0	0	0	0	0	0
10	17	25	-2	0	-35	-99	99	80	-2	-4	11	2	-26	-91	0	0	0	0	0	0	0	0	0	-68
5	-9	-7	-32	-1	99	0	0	0	-99	-21	-10	-21	-12	-45	-99	0	0	0	0	0	0	0	-99	-45
0	-16	-10	-28	-77	0	0	0	0	0	-99	-48	-24	-23	-25	-6	99	0	0	0	0	0	-83	-54	-33
-5	-30	52	99	0	0	0	0	0	0	0	99	15	-28	-5	22	36	0	0	0	0	0	-83	-32	-7

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	0	0	-16	27	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	99	99	40	-21	1	17	-13	-41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	-99	-2	43	21	15	10	11	26	4	-44	-72	0	0	0	0	0	0	0	0	0	0	0	0
20	99	46	39	46	30	1	15	6	29	34	71	99	-99	0	0	0	0	0	0	0	0	0	0	0
15	81	51	22	29	32	4	61	50	25	37	28	24	29	0	0	0	0	0	0	0	0	0	0	0
10	53	28	41	32	9	-32	55	99	60	34	50	47	18	-88	0	0	0	0	0	0	0	0	0	99
5	42	24	36	73	99	0	0	0	-99	32	50	43	45	26	-33	0	0	0	0	0	0	0	23	53
0	51	26	31	99	0	0	0	0	0	54	67	58	45	32	31	92	0	0	0	0	0	-29	20	39
-5	33	83	99	0	0	0	0	0	0	0	45	46	47	49	41	25	0	0	0	0	0	-29	44	44

TABLE 27
Corrections Applied to the Cape 3-25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
5	-54	-18	0	-7	14	12	11	-18	-55	-62	-82	-55	-52	-68	-19	-43	-31	-42	-18	-42	-52	-84	-83	-81
0	-25	-5	-3	-20	-17	-29	-17	-22	-26	-19	-25	-14	-19	-29	0	-27	-29	-42	-49	-55	-46	-52	-55	-42
-5	8	6	2	-26	-27	-46	-31	-26	-17	-4	-4	-1	-22	-17	-5	-24	-28	-35	-50	-53	-38	-24	-26	-1

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
5	9	-3	58	84	68	15	0	3	-9	17	50	75	50	13	28	16	34	20	13	31	43	42	51	25
0	25	15	30	40	44	17	19	17	19	27	39	46	32	15	30	19	40	29	40	43	48	35	37	27
-5	35	26	19	22	34	25	30	26	31	32	32	28	22	21	33	21	42	33	57	55	60	38	38	38

TABLE 28

Corrections Applied to the W 40

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	-99	-50	1	15	36	13	-12	-64	-99	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	99	-32	-42	-18	-11	3	-17	-36	-54	-57	47	0	0	0	0	0	0	0	0	0	0	0	0
25	-24	99	22	19	-17	-14	-18	-20	-12	3	-11	15	-95	99	0	0	0	0	0	0	0	0	0	-24
20	-16	5	-18	-12	-31	-18	-30	-22	-23	-34	-59	21	49	99	0	0	0	0	0	0	0	0	0	-33
15	-10	-25	-26	-45	-55	-30	-37	-28	-55	-52	-47	4	26	93	-40	0	0	0	0	0	0	0	0	-82
10	8	-31	-41	-56	-73	-53	-66	-38	-54	-40	-42	-25	-31	-23	-39	79	0	0	0	0	0	99	99	99
5	-25	-40	-44	-50	-31	-39	-43	-79	-65	-63	-42	-31	-33	-29	-24	-29	-24	-81	-36	-37	-16	-12	-18	-14
0	-38	-41	-36	-35	-25	-32	-28	-50	-38	-40	-31	-34	-33	-30	-29	-38	-35	-57	-29	-40	-41	-39	-44	-47
-5	-30	-22	-32	-33	-35	-42	-33	-43	-29	-24	-28	-30	-46	-35	-42	-44	-39	-42	-28	-47	-60	-52	-51	-43

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	93	28	15	16	3	12	-55	-71	-99	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	-99	-1	-5	-4	-5	-10	-15	-50	-38	-61	99	0	0	0	0	0	0	0	0	0	0	0	0
25	-99	-99	9	15	20	-1	-6	-17	-10	11	7	27	-99	-99	0	0	0	0	0	0	0	0	0	-99
20	-99	-99	-12	21	8	5	-2	-4	-3	1	-11	-47	-74	-99	0	0	0	0	0	0	0	0	0	-99
15	-78	-30	4	26	6	19	20	28	18	-8	-9	-5	12	28	88	0	0	0	0	0	0	0	0	-99
10	6	31	15	34	39	54	65	38	18	1	11	35	6	12	-49	99	0	0	0	0	0	97	4	37
5	2	20	7	-7	-27	0	44	39	-2	11	-6	2	-18	-21	-20	-29	-21	-40	-49	-61	-16	0	2	5
0	7	13	3	-4	-22	-10	6	11	-4	7	12	-2	-2	-16	-9	-15	1	0	2	-22	1	-5	12	6
-5	-1	1	13	26	1	-5	-7	7	2	12	15	0	10	10	13	-7	7	14	33	18	34	10	24	-3

TABLE 29
Corrections Applied to the W 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-21	-21	-21	-21	-21	0	0	0
45	-54	-76	-67	-19	4	12	-99	-91	-99	99	0	0	-99	-99	-47	24	27	24	-23	-43	-72	-46	-37	-29
40	-23	-47	-69	-19	11	29	-81	-46	-73	99	0	0	-99	-99	-57	-20	-6	-1	-32	-46	-71	-21	-15	-9
35	-13	-39	-73	-30	-16	-33	-68	-30	-7	99	0	0	-99	-99	-73	-60	-51	-51	-58	-58	-50	5	1	1
30	-1	51	10	16	-17	-6	-23	1	-25	2	-51	96	-99	-99	-98	-99	-97	-99	-99	-99	99	99	30	8
25	-14	-2	-6	-7	-18	-26	-41	-39	-52	-37	-51	-28	-99	0	0	0	0	0	0	0	0	0	0	0
20	-15	-42	-52	-55	-35	-44	-53	-68	-61	-59	-67	-53	-59	99	0	0	0	0	0	0	0	0	0	99
15	-22	-21	-37	-36	-45	-45	-49	-57	-55	-54	-54	-35	-35	19	-99	0	0	0	0	0	0	0	-39	3
10	-49	-39	-52	-39	-68	-64	-99	-7	-40	-33	-52	-46	-37	-25	32	-99	0	0	0	0	0	-99	-68	-40
5	-36	-33	-37	-26	-28	34	-99	99	-9	-26	-48	-53	-45	-38	-30	-22	-99	0	0	0	0	-99	-55	-47
0	-41	-50	-34	-41	19	43	0	99	36	5	-39	-45	-71	-55	-70	-37	-99	0	0	0	91	-65	-46	-54
-5	-39	-70	-69	-99	-99	0	0	0	99	73	-14	-17	-48	-40	-52	-39	-70	0	0	0	91	-49	-34	-56

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-42	-42	-42	-42	-42	0	0	0
45	-4	-17	-64	-71	-70	-88	-15	-99	-71	-99	0	0	99	99	84	-16	-24	-4	-27	-32	-56	-8	-1	50
40	-29	-16	-29	-42	-23	-50	-13	-99	-93	-99	0	0	99	67	15	-32	-36	-3	-17	-22	-69	-17	-41	-41
35	-37	-26	-5	-16	8	-36	-21	-60	-47	-99	0	0	99	18	-17	-36	-51	-32	-41	-35	-85	-24	-61	-72
30	-72	-64	-7	-17	-17	-32	-31	-51	-18	-25	43	-45	12	10	-13	-40	-74	-92	-99	-99	99	-99	-99	-99
25	40	-9	8	-17	-11	-45	-57	-61	-32	-42	-24	-53	36	0	0	0	0	0	0	0	0	0	0	0
20	-41	-36	-30	-29	-20	-48	-51	-43	-26	-39	-27	-22	22	99	0	0	0	0	0	0	0	0	0	56
15	-15	-19	-46	-50	-39	-57	-53	-63	-57	-60	-56	-41	-36	6	-99	0	0	0	0	0	0	0	-99	46
10	-43	-33	-51	-65	-58	-77	-51	-95	-57	-51	-48	-55	-65	-70	-93	99	0	0	0	0	0	99	-99	-33
5	-50	-48	-62	-80	-99	-99	99	-99	-25	-45	-43	-67	-72	-62	-46	53	99	0	0	0	0	-61	-58	-47
0	-51	-37	-35	-24	-29	-99	0	-99	-27	-59	-66	-77	-78	-75	-67	-58	15	0	0	0	99	-32	-44	-47
-5	-67	-65	-68	-38	-35	0	0	0	99	-62	-44	-60	-54	-84	-80	-99	-84	0	0	0	99	-6	-29	-52

TABLE 30
Corrections Applied to the W ZOD 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	-99	-12	5	33	53	68	94	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0
30	-69	-36	-22	2	6	16	10	5	-3	-12	-18	-90	0	0	0	0	0	0	0	0	0	0	0	0
25	-24	-34	-19	-17	-5	-12	-6	-4	-4	-3	-7	-3	3	0	0	0	0	0	0	0	0	0	0	49
20	15	2	1	-9	-12	-9	-9	2	-21	-15	-2	5	32	-99	0	0	0	0	0	0	0	0	0	0
15	-9	-10	-11	-17	-13	-9	-6	-1	-19	-18	-9	-18	-18	-51	-23	0	0	0	0	0	0	0	-99	-10
10	-19	-17	-24	-13	-10	4	-10	-5	-11	-10	-20	-23	-18	-23	-3	-99	0	0	0	0	0	44	-24	-9
5	-37	-29	-41	-15	-19	99	-99	94	-33	-21	-31	-17	-15	-14	-19	-40	-34	0	0	0	0	-19	-37	-29
0	-34	-23	-32	-22	-65	99	0	99	-95	-53	-48	-39	-37	-37	-34	-34	24	0	0	0	-99	-58	-47	-37
-5	-21	-7	9	28	-99	0	0	0	66	-43	-11	-27	-17	-44	-25	-40	47	0	0	0	-99	-94	-64	-48

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	99	-22	-11	-25	5	14	63	54	62	0	0	0	0	0	0	0	0	0	0	0	0	0
30	-33	40	99	62	43	15	0	32	13	9	-76	-99	0	0	0	0	0	0	0	0	0	0	0	0
25	19	13	34	19	12	-15	-12	19	17	-4	-29	-69	-30	0	0	0	0	0	0	0	0	0	0	17
20	21	16	9	6	7	-8	-1	9	18	13	1	1	-9	99	0	0	0	0	0	0	0	0	0	83
15	-8	-6	-7	-4	2	-8	-4	4	15	14	9	-14	-14	-60	99	0	0	0	0	0	0	0	-99	2
10	-21	-9	-6	-8	-6	-30	-92	-47	-6	16	19	13	27	17	69	-99	0	0	0	0	0	99	-63	-25
5	-11	0	-9	-2	-11	5	-99	99	-3	6	-4	6	11	-20	-32	-99	81	0	0	0	0	79	0	8
0	-18	-26	-41	-52	-85	99	0	99	-50	-12	-8	-3	-2	-15	-12	-24	70	0	0	0	-43	-14	-12	-11
-5	-3	-37	-51	-99	-99	0	0	0	99	99	50	42	15	21	24	39	59	0	0	0	-43	-14	-1	-1

TABLE 31
Corrections Applied to the Cape 1-50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	29	27	2	2	5	48	81	13	-54	33	66	-46	-72	-27	1	23	-37	-18	28	-25	-48	12	9	6
30	-6	24	-14	5	2	-16	-30	-21	6	26	10	24	-8	-28	-4	0	-13	18	11	-21	-44	-12	-19	-35
25	-10	30	-40	-65	62	-6	-10	-16	-7	38	-27	-12	4	-28	10	11	-13	-9	-8	22	-34	-38	18	25
20	-25	-9	-12	-31	-1	-2	-1	12	0	11	8	2	-24	-33	-26	4	-24	-49	-30	19	35	3	1	-2
15	-8	-19	-4	48	17	12	19	-8	-11	-5	-26	33	66	22	0	5	-21	-8	-3	-19	1	-63	-21	-5
10	-13	-6	1	-1	0	26	-17	-28	10	-27	13	-6	-45	-17	-53	-47	-44	25	50	-49	-30	-7	-7	-8
5	18	9	16	-4	-8	-13	-30	-18	-32	5	8	15	4	-3	-2	3	26	6	9	-4	-23	35	18	20
0	-15	-4	-32	-8	24	-19	-14	-14	-17	-11	-33	-23	-22	-16	31	-65	-99	-15	-26	15	-7	-47	17	-18
-5	19	10	23	3	-33	-41	10	10	27	19	-22	-19	-9	8	36	6	-45	20	-5	33	60	5	50	17

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	-17	-33	-40	-99	-96	-99	-99	-62	-26	-22	-26	-9	-13	-47	-18	-46	-51	-13	24	-12	-35	72	55	45
30	18	32	45	21	10	5	11	17	8	1	-11	2	0	2	41	12	18	0	-10	-12	-10	98	30	-5
25	9	27	-13	11	65	32	0	8	34	23	20	39	53	46	54	-30	-4	25	28	-60	43	49	15	-7
20	18	-44	-39	6	5	11	-8	12	14	9	10	6	-8	18	6	-19	1	57	26	-46	-32	3	20	37
15	-7	17	53	80	21	9	36	3	28	35	-33	13	33	55	44	40	21	8	3	8	-2	63	24	2
10	40	4	62	1	-35	36	22	-9	-28	3	7	43	41	23	35	10	-14	5	43	63	10	-7	6	51
5	2	45	35	19	-5	41	83	-2	20	18	25	39	38	29	31	39	68	27	9	26	38	4	39	68
0	15	18	-14	29	26	22	27	5	24	28	36	46	-4	11	-8	-26	30	34	30	20	36	26	28	43
-5	32	22	41	36	12	10	35	32	36	51	77	26	11	47	21	43	41	25	31	48	44	9	31	50

TABLE 32
Corrections Applied to the Bord 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	-16	41	-91	-99	-99	-61	-64	-99	-99	-99	-99	-99	99	-20	-99	-99	-99	-99	27	99	60	-71	-99	-15
20	-33	-12	-77	-71	-99	-59	-58	-63	-85	-99	-91	-79	-29	-99	-99	-53	-31	-81	-26	0	-68	-83	-73	-38
15	-54	-52	-71	-68	-44	-47	-60	-59	-89	-98	-73	-56	-53	-89	-86	-49	-51	-59	-70	-62	-77	-73	-74	-58
10	-79	-47	-21	-83	-58	-61	-77	-58	-99	-95	-99	-84	-89	-93	-87	-74	-86	-47	-84	-74	-67	-54	-87	-86
5	-96	22	99	-99	-99	-99	-99	-77	-99	-99	-99	-99	-99	-99	-94	-77	-66	-9	-65	-75	-81	-48	-99	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	99	99	99	99	99	99	99	99	99	99	99	82	82	99	99	99	53	-37	-73	40	92	99	99	99
20	63	67	71	81	57	70	76	65	50	81	62	32	19	46	51	73	63	47	23	34	58	64	69	38
15	31	17	10	38	25	22	8	22	23	34	32	24	33	37	55	59	47	60	52	37	47	32	28	10
10	78	49	34	47	30	-11	-5	28	33	4	12	26	56	50	80	82	75	93	76	52	60	52	48	48
5	99	99	99	81	36	-52	35	64	44	-44	-29	12	52	65	99	99	99	99	99	69	68	99	99	99

TABLE 33
Corrections Applied to the ALB99 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	-99	-99	-99	-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-99	-99	-99
5	-72	-68	-77	-31	-44	3	-53	-59	-99	-99	-99	-99	-77	-36	-5	-20	-9	-69	-48	-99	-67	-78	-34	-92
0	-63	-11	-47	-14	-44	-16	-70	-60	-87	-53	-83	-75	-61	-31	-25	-49	-48	-81	-58	-99	-77	-69	-33	-45
-5	-83	23	-27	-6	-37	-25	-65	-50	-56	-23	-51	-46	-43	-22	-48	-86	-82	-85	-57	-99	-99	-99	-99	-86

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	99	99	-99	-89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	99	99
5	30	29	1	-39	-7	1	9	21	47	61	87	90	52	5	50	-24	-26	-6	27	99	99	99	85	59
0	-28	13	-8	-39	-23	-11	0	19	32	33	33	57	26	8	45	-30	-4	5	11	44	80	38	-12	-42
-5	-73	-5	-18	-40	-38	-18	-6	25	48	29	-4	12	-8	16	38	-39	-1	7	7	-25	-2	-41	-70	-99

TABLE 34
Corrections Applied to the Mun97 00ii

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
55	0	12	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	-91	-46	-49	-46	-70	-99	-99	-99	-77	-74	-77	-99	-99	-20	-16	-6	-99	-99	-99	-44	-40	-59	-85	-58
45	-58	-57	-67	-80	-76	-85	-82	-78	-84	-89	-74	-86	-89	-89	-92	-65	-73	-87	-67	-78	-87	-95	-95	-72
40	-79	-87	-84	-97	-79	-87	-98	-90	-78	-80	-82	-84	-95	-99	-99	-99	-99	-99	-96	-93	-92	-73	-88	-98
35	15	15	4	-4	-76	-29	-31	-94	-87	-99	-99	-88	-77	-87	-27	-49	-99	-99	-99	-81	-75	-37	26	0

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
55	0	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	17	37	-25	-27	-65	-99	-63	99	-5	-7	-31	-99	-99	-99	-99	-99	18	24	-18	10	22	-9	-96	-99
45	-14	-15	-23	-24	-20	-44	-37	-26	-24	-27	-47	-47	-3	-16	-51	-39	-44	-35	-10	0	-15	-24	-38	-68
40	-32	-25	-19	-27	-25	-17	-30	-26	-30	-16	-35	-31	-18	-16	-20	-15	-14	-23	-24	-33	-27	-8	-14	-52
35	40	40	99	99	41	13	-17	-38	-24	12	-19	-44	-38	34	23	-77	-51	-25	-16	-37	-29	2	29	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	19	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	19	0	0	0	0	0	0

TABLE 35
Corrections Applied to the Mun97 00ii

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
70	0	0	0	0	0	99	99	99	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	-37	-40	-45	-38	-34	-33	-35	-30	-29	-31	-31	-14	-29	-42	-52	-35	-13	-19	-15	-25	-28	-37	-30	-32
60	-34	-40	-45	-37	-30	-32	-46	-43	-44	-44	-48	-40	-52	-48	-52	-50	-31	-32	-30	-38	-37	-47	-38	-32
55	-29	-44	-51	-40	-27	-25	-43	-42	-47	-50	-55	-49	-57	-42	-49	-55	-46	-41	-39	-48	-47	-53	-42	-31
50	-16	-37	-58	-49	-30	-16	-40	-45	-50	-57	-60	-53	-54	-29	-44	-61	-74	-62	-57	-58	-56	-55	-39	-24

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	23	32	9	4	26	45	26	-18	-40	-43	-19	-15	20	20	6	2	-3	-10	6	16	26	22	2	11
60	-7	12	-4	-5	7	15	1	-10	-8	-17	-10	-21	-1	0	-14	-15	-9	-13	-3	10	16	18	-6	-9
55	-31	-5	-9	-12	-10	-11	-21	-21	-7	-16	-14	-26	-10	-15	-37	-46	-27	-24	-21	-12	-11	3	-23	-28
50	-73	-57	-43	-62	-58	-59	-54	-45	-28	-35	-33	-33	-15	-29	-67	-93	-61	-41	-57	-66	-81	-42	-59	-62

TABLE 36
Corrections Applied to the Kon 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	99	48	31	-8	-35	-41	-57	-35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	-99	-88	-39	-47	-52	-70	-91	-85	-99	-99	-99	-99	0	0	0	-58	-56	-54	-51	-45	25	-99	-99	-99
25	-69	-52	-62	-65	-82	-93	-99	-98	-99	-90	-99	-99	-99	-99	-64	-77	-80	-85	-99	-99	-99	-97	-99	-82
20	-38	-44	-61	-69	-85	-98	-99	-99	-99	-95	-99	-99	-99	-13	-85	-70	-72	-79	-94	-89	-94	-82	-99	-29
15	-51	-60	-70	-77	-81	-94	-99	-99	-99	-90	-96	-86	-90	-61	-75	-49	-50	-59	-71	-74	-82	-64	-1	-40
10	-67	-77	-83	-75	-65	-50	-75	-83	-88	-92	-96	-90	-87	-82	-46	-26	-25	-36	-52	-63	-73	16	-21	-58
5	-64	-64	-77	-68	-78	47	99	-99	-99	-99	-99	-99	-93	-96	-86	-99	99	0	0	0	0	-38	-58	-55
0	-63	-55	-64	-66	-99	0	0	-99	-86	-99	-99	-99	-89	-85	-78	-75	-70	0	0	0	-68	-99	-80	-70
-5	-66	-72	-71	-96	-12	0	0	0	-99	-99	-99	-94	-75	-63	-67	-65	-99	0	0	0	-68	-99	-88	-77

TABLE 37
Corrections Applied to the Pulk99 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	-91	-25	-99	-99	-99	-66	18	-99	-94	-99	-26	99	99	99	7	28	2	-39	-33	-72	-80	-68	-95	-70
15	-38	15	1	-15	-34	-5	-4	-72	-55	-92	-73	2	-19	-23	-68	-37	-12	-43	-31	-60	-69	-82	-85	-66
10	-49	-36	-29	-48	-48	-32	-39	-50	-32	-81	-67	-84	-90	-70	-60	-39	-37	-63	-64	-65	-11	-50	-31	-74
5	-78	-52	-34	-46	-84	-62	-99	-99	-82	-97	-54	-94	-99	-71	-40	-27	-52	-79	-70	-67	-17	-65	-61	-99
0	-84	-70	-20	-26	-75	-67	-60	-78	-99	-91	-86	-81	-99	-81	-57	-33	-53	-76	-81	-99	-63	-72	-67	-99
-5	-19	-46	-31	-77	-75	-87	-55	-61	-85	-44	-44	-1	-54	-37	-45	-40	-68	-83	-81	-99	-69	-60	-52	-84

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	99	-4	99	81	76	20	99	93	65	25	-41	-55	-71	-28	-3	26	74	47	70	23	79	28	99	69
15	59	-8	27	18	24	8	16	2	5	5	-22	-19	-3	17	41	37	63	24	24	-1	35	21	62	25
10	22	-14	17	26	49	45	16	-28	-16	-18	-4	-14	4	7	19	3	19	16	-9	-11	-24	13	14	0
5	38	13	23	22	39	49	40	-1	0	-11	16	8	2	-3	9	25	44	57	39	23	22	30	35	34
0	22	8	8	-13	-1	9	26	12	-4	6	8	-5	-19	-9	7	29	26	13	1	-6	12	2	23	19
-5	-28	-46	-12	-35	-5	0	11	11	-45	-36	-38	-32	-25	-22	-21	-14	-19	-23	-37	-15	-4	-21	-9	-34

TABLE 38

Corrections Applied to the Madn 10

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	78	83	0	0	84	84	84	-99	-99	-99	0	0	0	0	0	0	0	0	-44	-44	-87	-99	-50	51
30	-41	-63	3	56	-13	-28	-26	-67	-56	-48	-83	-28	-18	-50	13	-16	-22	19	-56	-41	-6	6	-34	-34
25	-19	-41	-31	-88	-92	-19	29	7	-1	-88	17	55	44	-44	-41	-66	-66	-34	-79	-40	-15	-17	-15	-15
20	2	-21	-14	37	70	-35	-99	-99	3	-71	-53	-72	-40	-67	27	-18	-54	-60	-50	-18	-51	-18	-78	-54
15	8	-38	-47	-52	-22	-15	22	-80	-85	-67	-67	-19	19	-71	-41	-16	-14	25	0	-59	-36	1	11	14
10	-1	48	-55	-27	-21	28	41	-99	-82	-22	-25	-53	-99	-13	-14	-70	-7	14	23	-6	-24	19	-24	-54
5	-38	-99	-8	44	18	-59	-11	-38	-82	-29	-13	40	-49	-27	-22	-24	2	-53	-88	-47	14	65	-41	-1
0	19	8	3	-22	-57	-16	-2	-68	-29	-49	-48	0	-27	-3	-25	-10	-46	-28	14	-19	-42	-54	12	24
-5	-34	-48	-31	-12	-52	-99	-74	-99	-99	-14	-40	-66	-43	-48	-8	-9	-33	11	-28	-72	-32	6	-64	-70

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	-94	-99	0	0	99	99	99	97	97	97	0	0	0	0	0	0	0	0	-34	-34	94	99	99	-24
30	28	10	-34	99	53	-20	19	58	48	-97	-59	58	7	-5	-11	-61	26	31	21	11	-28	49	-6	12
25	35	8	15	17	-79	18	-52	-99	-90	58	27	15	10	22	33	50	63	5	5	14	27	20	7	24
20	31	10	13	49	93	70	4	99	99	83	-38	24	-5	14	81	56	78	53	-12	55	44	-51	58	1
15	39	-17	-2	4	-23	0	37	7	-55	-63	99	78	27	15	17	50	33	-16	43	47	29	28	-2	-13
10	-19	63	61	7	51	34	12	-40	50	8	35	15	96	0	-9	94	74	32	58	35	-4	39	45	-21
5	35	-40	-35	8	8	71	94	48	99	52	11	-79	27	46	15	73	32	15	20	31	15	74	35	11
0	65	-14	-18	-27	-34	19	-30	-77	-33	34	20	-9	-28	-26	-32	-6	62	36	6	48	11	41	39	8
-5	10	59	36	77	27	26	10	-1	-99	-99	99	56	54	64	97	99	45	38	33	56	20	68	-33	-26

TABLE 39
Corrections Applied to the Berg 1-25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
75	-99	-56	-16	22	22	22	22	-99	-99	-99	-99	-59	58	1	-53	-53	-53	0	0	0	-99	-99	-99	-99
70	-87	-92	-58	-37	-36	-36	10	1	-34	-50	-58	0	11	8	-47	-47	-46	-7	-77	-53	-54	-6	-37	-33
65	-81	-85	-68	-50	-38	-32	16	99	17	-21	-73	-43	-19	7	0	-27	-49	-69	-67	-51	-54	-7	-23	-37
60	-66	-86	-74	-62	-49	-33	-26	3	-34	-43	-80	-62	-20	3	5	-94	-96	-84	-37	-52	-73	-65	-47	-53
55	-91	-95	-83	-61	-49	-50	-81	-53	-69	-54	-92	-87	-60	-49	-83	-99	-94	-71	-40	-52	-56	-55	-38	-49
50	-59	-48	-50	-41	-48	-70	-81	-41	-54	-46	-75	-67	-38	-63	-96	-81	-82	-59	-51	-45	-59	-65	-67	-59
45	-23	-5	-64	-59	-74	-68	-89	-83	-81	-82	-94	-92	-54	-66	-72	-66	-75	-72	-73	-39	-74	-90	-99	-49
40	-57	-62	-92	-80	-70	-65	-90	-99	-99	-99	-99	-99	-75	-90	-99	-99	-79	-74	-78	-50	-91	-94	-99	-34
35	-56	-72	-61	-79	-71	-85	-99	-99	-99	-99	-99	-99	-92	-80	-99	-99	-99	-86	-77	-66	-99	-99	-89	-82
30	-51	-61	-55	-80	-99	-66	-72	-99	-99	-97	-96	-92	-67	-10	-33	-44	-98	-86	-74	-79	-61	-92	-37	-89
25	-90	-77	-38	-68	-99	-99	-99	-99	-99	-99	-99	-94	-88	-81	-98	-99	-97	-99	-99	-84	-71	-85	-99	-99
20	-90	-69	-64	-82	-79	-82	-99	-99	-99	-99	-99	-99	-92	-84	-92	-84	-99	-72	-98	-50	-69	-69	-94	-75
15	-94	-59	-65	-71	-84	-75	-93	-99	-99	-99	-96	-94	-92	-85	-92	-77	-99	-63	-64	-35	-71	-79	-91	-60
10	-80	-52	-52	-84	-99	-99	-99	-99	-99	-99	-99	-87	-99	-99	-99	-99	-86	-68	-46	-33	-62	-86	-83	-75
5	-78	-60	-43	-55	-70	-49	-67	-13	-99	-99	-99	-99	-99	-97	-93	-70	-54	-99	-81	-77	-31	-49	-69	-59
0	-88	-57	-89	-68	-77	18	-63	-99	-99	-99	-77	-68	-90	-57	-84	-63	-83	-99	-93	-77	-58	-92	-99	-64
-5	-93	-37	-24	34	14	99	-99	-99	-99	-34	-99	-94	-98	-61	-75	-77	-81	-84	-77	-87	-99	-99	-99	-87

TABLE 39 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
75	-99	-99	-66	61	61	61	61	-35	-35	-41	-61	-99	-99	-70	46	46	46	0	0	0	-99	-99	-99	-99
70	-52	-53	-61	-11	0	0	60	55	50	37	-11	-76	-97	-48	38	27	37	75	-16	-6	-15	39	-8	9
65	-30	-44	-65	-95	-28	-2	28	85	42	48	-10	-13	-40	-21	-3	-13	9	24	28	6	0	57	23	32
60	-9	-22	27	-37	2	-11	24	-27	-34	-28	-20	11	36	11	-13	17	30	9	48	-4	29	16	39	10
55	-28	-55	-6	-57	2	-16	-43	-67	19	17	-4	28	85	23	-14	27	58	29	34	7	31	-19	-1	-44
50	-2	-20	-3	-28	22	-5	-78	-99	-1	23	-27	-11	27	24	56	29	45	29	7	3	2	-42	-10	9
45	72	79	99	99	99	57	3	64	18	26	-5	18	32	68	81	32	40	49	-4	0	-8	-17	21	61
40	74	28	62	64	99	98	53	34	24	32	28	61	82	98	36	9	53	71	81	34	43	47	99	80
35	4	-6	6	14	38	19	-24	-40	-15	-12	8	65	57	64	25	19	52	40	38	13	34	48	10	26
30	-29	77	62	94	31	-2	-11	12	52	27	12	39	35	99	2	-36	45	65	37	31	-19	61	-76	44
25	-1	19	50	70	17	-37	20	-5	70	50	35	38	26	73	28	31	38	44	36	22	-27	-14	-9	61
20	20	-7	8	43	48	27	58	-8	22	-4	-12	30	5	35	23	44	44	-24	3	30	43	35	55	78
15	47	56	51	64	42	60	85	62	51	41	22	66	44	40	48	68	86	39	23	59	67	69	75	66
10	4	13	18	26	-46	-33	-87	-8	-9	5	-26	27	26	30	59	99	99	99	91	99	81	91	32	-3
5	-5	-18	-16	17	31	87	-71	-78	-45	-69	-42	-14	-9	-6	-8	15	99	60	11	24	30	28	-9	-12
0	13	11	-52	-75	-82	99	74	-7	-10	17	-6	-16	-22	13	3	-30	-34	-85	-52	-3	25	-17	-14	6
-5	-57	-9	13	90	99	-99	-40	-40	-18	15	-99	-32	-35	56	36	31	-29	-43	-21	-1	13	-42	-7	6

TABLE 40
Corrections Applied to the ABB-6 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0	-58	-70	-99	-99	-99	-99	-99	-97	-92	-63	-82	-99	-94	-99	-99	-99	-99	-86	-80	-99	-99	-99	-99	-80
-5	-99	-82	-99	-99	-99	-99	-99	-99	-99	-99	-70	-99	-99	-99	-85	-83	-99	-93	-73	-99	-98	-89	-99	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0	5	-58	-15	-64	22	74	15	12	2	-5	9	58	91	80	84	75	85	86	84	99	0	51	32	-53
-5	7	-17	9	-27	34	50	27	12	28	2	-17	23	27	1	11	38	59	76	31	80	18	48	83	0

TABLE 41
Corrections Applied to the Buch 50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
15	-38	8	-15	-42	9	-77	-66	18	32	35	29	41	-17	-36	-19	40	25	3	-11	12	-40	-30	31	-25
10	-5	14	11	13	11	22	18	24	9	16	22	12	25	7	16	26	15	18	12	15	24	15	35	15
5	10	11	6	9	12	5	7	29	25	11	19	14	24	17	28	29	5	13	10	28	11	26	17	2
0	8	-1	-7	-7	5	0	2	9	-15	11	25	5	16	3	10	14	4	8	9	14	3	5	13	13
-5	1	4	9	-21	-7	9	11	20	18	2	15	4	13	8	5	4	-2	-7	-20	17	1	-12	-5	3

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
15	-99	-57	53	20	-17	-14	66	24	23	99	50	-29	-41	-17	12	6	-11	-12	29	1	-52	-99	-13	58
10	-13	-20	-16	-17	-5	-6	-8	14	-14	-10	-8	21	5	-9	-9	-11	6	-9	-32	-19	13	0	7	10
5	-9	-17	-20	9	2	-9	-16	-9	-7	-13	-12	-3	4	-10	-17	-8	-11	-2	-22	-21	-27	-45	-34	-3
0	-2	-15	-15	1	-10	-28	-26	-14	-19	-13	-8	-23	-17	-12	-30	-17	-20	-5	-11	5	-1	-17	12	-11
-5	-21	-4	-23	-6	-12	0	-4	6	19	6	-6	-9	15	2	5	10	7	-22	10	20	11	-9	-11	-32

TABLE 42
Corrections Applied to the Bonn09 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
55	7	8	0	-99	-99	51	79	99	-22	-34	-99	-99	-66	-46	-99	-99	-99	-99	-90	-95	-99	-76	-30	-1
50	-28	-29	-2	-50	-50	-99	-99	-73	-80	-22	-54	-98	-62	-92	-99	-99	-99	-99	-67	-36	-85	-85	-88	-80
45	-37	-72	-69	-72	-26	-99	-97	-90	-97	-42	-57	-66	-72	-88	-76	-74	-99	-62	-95	-48	-81	-99	-87	-99
40	-12	-71	-78	-90	-45	-99	-59	-28	-99	-49	-84	-59	-68	-75	-58	-53	-91	-51	-96	-31	-37	-73	-38	-79
35	7	-73	-85	-89	-59	-79	-75	-25	-99	-39	-99	-53	-65	-76	-71	-73	-94	-58	-70	35	58	37	45	12
30	0	0	0	0	-99	-99	-99	-99	-99	0	0	0	0	0	0	-27	-27	-27	-27	-27	0	0	0	0
25	0	0	0	0	-99	-99	-99	-99	-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	-31	-9	-2	-5	-15	-10	-43	-30	-90	-48	-67	-44	2	-7	-15	-7	20	90	62	-12	-99	-99	-69	32
50	15	3	-4	-1	4	31	28	37	-20	1	-15	9	30	13	12	30	-6	5	-11	-30	-60	-12	15	49
45	48	21	18	0	-6	6	21	42	-1	2	-4	21	19	14	18	39	6	16	14	22	22	60	45	41
40	15	-5	17	15	10	6	6	34	-1	11	-5	27	11	51	28	41	14	41	39	17	-21	27	3	13
35	-38	-34	15	50	65	54	38	38	18	36	24	62	45	99	68	51	-6	-6	21	-41	-99	-83	-95	-38
30	0	0	0	0	63	63	63	63	63	0	0	0	0	0	0	-99	-99	-99	-99	-99	0	0	0	0
25	0	0	0	0	63	63	63	63	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 43
Corrections Applied to the ABB+20 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	-48	-85	-99	-30	-99	-99	-72	-18	-13	-67	-99	-99	-99	-99	-99	-99	-99	-75	-99	-84	-99	-99	-99	-99
25	-66	-65	-64	-87	-92	-92	-98	-99	-99	-99	-99	-99	-99	-91	-99	-99	-99	-87	-74	-70	-98	-86	-86	-93
20	-53	-55	-52	-83	-99	-99	-99	-99	-99	-99	-92	-99	-99	-99	-99	-99	-99	-80	-65	-76	-81	-82	-83	-71
15	-99	-99	-99	-96	-99	-99	-99	-99	-99	-99	-99	-94	-99	-99	-99	-99	-99	-99	-99	-74	-28	-39	-45	-98

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	51	12	-16	22	39	75	-40	-86	49	44	59	-70	-99	-64	-99	-59	-25	8	37	47	79	99	67	50
25	11	5	-8	23	13	7	-6	-21	-2	9	11	-15	-11	1	24	7	19	16	8	-9	-8	2	0	20
20	27	21	13	23	37	23	15	19	11	32	31	11	30	24	34	21	35	42	28	39	46	19	19	46
15	36	14	43	45	77	10	-6	37	20	55	35	-17	38	35	55	68	68	70	21	23	56	74	54	71

TABLE 44
Corrections Applied to the ABBO 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	-76	-99	-89	-46	-99	-99	-35	-99	-99	-99	-72	-35	-71	-99	-99	5	-81	-99	-84	50	-61	-99	-99	-99
5	-53	-78	-99	-80	-99	-99	-98	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-96	-91	-75	-86	-99	-83
0	-71	-58	-67	-85	-99	-99	-99	-99	-78	-94	-99	-99	-99	-99	-99	-93	-77	-98	-99	-99	-98	-99	-99	-98
-5	-99	-99	-98	-85	-92	-99	-99	-99	-92	-99	-99	-99	-99	-73	-99	-99	-70	-84	-99	-99	-99	-99	-97	-93

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	99	99	-5	75	99	99	99	99	-26	99	99	96	99	99	99	99	99	99	99	99	99	99	99	99
5	-5	-6	-39	-36	-30	-9	-40	1	-36	-15	-57	-28	-24	-21	-54	-23	-4	4	-4	-6	-22	-33	9	-21
0	25	19	8	-20	-22	-2	-18	-1	-26	-4	7	0	-9	25	27	28	3	14	34	24	30	30	19	-1
-5	-11	-67	-66	-72	-29	-38	-60	-11	-15	-24	-33	-10	-21	-17	-35	6	-17	-32	-11	-8	-15	-4	14	1

TABLE 45
Corrections Applied to the Lund44 50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	-46	-22	77	24	-7	-47	-60	1	1	1	0	-98	-98	-98	0	0	0	0	0	0	0	0	0	0
45	-13	-52	-23	4	-99	16	12	-88	36	-65	-73	-21	66	99	-60	-99	-99	-99	-99	-99	57	99	73	24
40	-1	-17	-42	15	-47	13	-21	18	-5	-57	49	-26	-24	-29	-15	-1	99	-20	-17	26	3	-36	-48	-34
35	-23	-10	-8	-20	-20	-13	-40	-18	-17	-17	-8	-26	-8	-44	-39	88	-77	14	-14	-29	-20	-8	-8	-24
30	-7	-12	6	-4	-11	-3	-22	20	-10	-40	-29	0	-45	-3	-13	-6	4	-6	13	1	7	-10	5	-1
25	-36	6	10	-17	-10	20	-14	-32	-21	10	-7	15	-19	-52	14	86	62	43	8	20	-14	-1	6	-14
20	-55	-1	-71	-15	-24	-10	28	-38	-30	-46	-39	-11	17	-68	-56	30	-50	-14	25	-18	-20	-32	-2	-21
15	-76	-87	15	-30	-67	-9	58	-9	-53	-44	-83	-1	-99	-99	1	10	3	-2	1	-7	53	46	-4	-25
10	39	-60	16	-64	-57	-35	-99	-98	19	-35	-30	-41	-13	40	31	-63	-96	-14	-19	21	-26	44	59	99
5	99	-99	-92	-41	-92	-43	-36	-14	-13	-66	-2	-9	-52	-34	-24	14	36	51	-77	-77	9	14	5	99
0	-43	-99	-97	37	-34	54	25	-99	80	29	-7	28	-52	-99	-99	-88	99	-40	-50	-62	-71	-99	-50	30
-5	-99	-99	0	0	0	0	0	17	17	-37	-54	-31	99	-41	-99	-99	0	-87	-28	18	-69	-28	21	-80

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	-99	-99	-72	99	99	99	-99	-99	-99	-99	0	-99	-99	-99	0	0	0	0	0	0	0	0	0	0
45	-18	25	43	-18	-54	-62	29	-62	-47	65	-55	-42	-39	88	99	71	99	99	-99	-99	-82	35	85	31
40	-41	75	38	22	-26	-2	5	46	16	37	84	-8	41	30	-2	18	5	-52	2	4	61	-4	9	-4
35	-32	-20	-20	-12	-37	-25	-3	-26	20	24	-16	-10	-29	-20	-61	69	-30	-76	-11	-20	-21	-24	-6	-46
30	-7	-42	24	-15	-2	6	4	-5	-36	16	4	-36	-8	-44	21	-6	18	21	9	-30	-4	-6	-8	-15
25	-64	-74	-4	-52	-36	-89	-66	17	-44	-39	-14	-34	-30	-59	-30	70	-37	5	-32	-72	6	2	-15	-13
20	22	3	53	33	-2	-20	19	-32	-4	-50	-48	-16	5	-45	-31	-12	-21	26	-10	-28	-11	35	-29	-29
15	-41	-52	30	-53	22	-74	94	85	29	16	41	39	34	31	17	24	55	35	-49	-28	8	-1	-49	-20
10	99	99	21	0	-7	-39	-17	-2	0	20	-23	-6	99	18	9	26	4	-22	35	21	-78	49	-95	-89
5	21	-97	34	70	41	20	34	-11	14	11	51	26	43	-53	-1	52	71	-99	-74	75	21	73	27	-2
0	15	-26	-73	-92	33	22	89	27	-27	36	40	-63	-99	-99	-28	25	88	22	19	7	5	4	13	47
-5	-99	-86	0	0	0	0	0	-99	-99	-87	-67	-85	-99	-99	-12	30	0	-99	-74	4	26	29	66	-99

TABLE 46

Corrections Applied to the Stras 30

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	-12	-16	-22	7	38	0	0	0	0	0	0	0	0	18	18	18	0	0	0	0	0	0
85	25	12	47	6	8	7	38	-8	-8	-7	23	-13	-20	-20	0	15	15	19	39	16	32	6	15	23
80	28	12	39	24	20	35	52	6	3	-30	-27	-43	-6	19	20	13	-1	-4	11	-24	17	47	35	27
75	55	66	30	-14	7	51	35	10	46	31	14	3	15	4	19	-9	-15	-1	56	86	90	51	22	27
70	70	65	-2	5	27	2	-3	10	40	-6	24	58	15	-11	46	24	10	5	30	12	39	29	51	18
65	57	81	44	17	25	67	52	-1	51	41	42	22	16	29	35	24	-2	29	-27	12	62	45	-10	-10
60	41	-9	-53	-59	-64	-4	99	99	26	52	-23	-50	-55	-82	-99	-14	5	35	34	68	23	1	74	99
55	67	30	5	-21	-17	1	-7	-8	-5	-9	-37	-65	-24	-14	-84	-46	-55	51	46	-9	21	57	-10	39
50	6	-37	-38	20	35	35	-13	-59	-17	22	-18	-33	49	19	-15	22	1	35	39	-34	-52	-5	-10	0
45	26	41	-70	-52	13	27	-1	8	24	35	35	95	24	-79	-31	0	25	-5	0	0	0	99	4	-4
40	55	18	-99	-68	14	14	2	21	35	20	32	15	56	57	-17	28	99	-75	8	50	39	15	15	62
35	51	25	-4	-2	41	5	-4	32	-11	-13	10	8	-10	-35	-2	9	-21	25	14	-20	-21	46	-8	-2
30	-9	33	63	50	70	76	37	11	4	9	30	70	20	8	-2	-7	-24	14	17	31	37	84	39	55
25	-10	23	27	2	-3	45	3	-70	55	60	23	83	62	-4	37	21	-7	-11	-12	12	49	55	-9	24
20	65	39	11	55	66	28	32	-36	-23	-40	-61	-3	-34	-37	-2	12	-41	42	27	50	5	-17	-26	11
15	5	93	17	-35	-12	-14	-16	-28	-27	31	55	40	-9	5	13	6	-52	-48	37	53	32	99	99	99
10	0	-5	54	-12	-51	43	-30	-2	-1	-2	14	-14	-20	12	13	42	22	80	99	-24	2	9	-19	-8
5	19	40	21	8	5	13	8	2	-3	-34	8	64	-47	4	17	0	-35	34	6	-14	23	-13	26	-7
0	60	-43	-39	13	18	70	16	-37	-15	15	-19	-21	4	-15	-30	5	-12	9	40	21	10	11	20	-12
-5	13	15	1	-14	-11	5	35	30	12	41	51	53	59	7	31	-7	20	-13	-15	-20	3	16	7	16

TABLE 46 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	31	24	-1	-2	22	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
85	13	-2	37	13	-5	-2	22	2	2	32	85	34	-84	-84	0	-41	-41	-40	-55	-50	-68	-44	44	40
80	-52	-2	46	25	-51	-80	-59	41	38	5	-44	-54	52	99	-29	-99	-86	5	-21	-13	-21	-39	-48	-54
75	-53	-58	-16	99	57	-31	-46	-31	-75	-60	-69	-99	-23	-66	-37	5	14	23	-86	-99	-26	-77	-96	-54
70	-74	-47	9	-4	-14	-8	-56	51	43	-48	-67	-34	59	-99	-99	-99	-38	-48	-84	-91	-45	-40	1	-29
65	-2	-40	78	85	38	14	32	44	17	60	-21	-70	-51	-88	-29	28	-19	-99	-31	36	46	97	65	27
60	3	-97	-99	-99	86	84	37	-9	-42	-55	-31	23	70	99	-3	-70	-87	-99	-99	-31	16	53	-78	-99
55	8	45	17	0	28	10	53	-5	-14	-16	-57	-72	-21	-12	-85	27	9	-46	-11	-1	-6	4	53	14
50	-27	7	-1	57	39	-5	53	-88	-9	15	-7	-6	-13	-52	-45	-13	99	99	62	89	95	23	23	9
45	53	88	-21	-26	-21	-1	7	58	38	-7	-7	-99	-92	-3	26	-33	-99	99	0	0	0	15	-1	10
40	-52	-24	32	-23	5	35	59	-11	-50	-17	-25	-92	-96	-58	-31	-56	-99	99	43	-99	-99	-99	-99	-61
35	-46	-38	89	99	26	-18	-5	-99	-66	-48	-63	-62	-53	-64	1	-45	-26	65	46	-32	-58	80	74	16
30	3	-11	-11	14	9	18	75	33	-14	12	-47	-20	0	-28	-55	25	-16	-29	-2	70	6	-86	-32	-1
25	-19	-5	-26	12	27	-12	10	25	-7	22	38	-70	-99	-33	-53	-38	20	-70	31	4	-99	9	36	-18
20	-60	-78	-38	73	-99	-96	-99	-88	-99	-79	-81	-47	-99	-93	-54	-84	46	-99	-99	-87	-99	-99	-93	-52
15	5	39	14	-54	-66	99	99	-13	-86	-84	-62	-33	-49	67	-68	-99	11	30	-83	-41	-19	-99	-24	-49
10	53	13	1	99	25	24	50	18	30	2	7	-27	-56	-55	25	7	-10	-41	-41	47	-63	-56	12	-49
5	-13	16	37	-51	34	7	-24	16	2	-32	-31	-8	1	33	55	-5	1	74	37	-99	-21	22	-34	19
0	32	-31	-2	2	-66	8	52	6	-66	-86	-38	-83	-82	-7	1	61	-77	-99	-19	-37	49	-14	-8	52
-5	-52	-41	-26	-2	37	-20	-28	-38	-3	45	-69	-99	-71	-32	-95	-18	12	30	99	25	-6	49	69	-45

TABLE 47
Corrections Applied to the Cin 00

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
80	0	0	0	0	99	79	79	7	49	73	18	-3	-99	-99	-99	76	76	76	76	76	0	0	0	0
75	35	-8	-24	-67	30	-8	25	-35	-14	11	-46	-11	-19	33	9	99	25	41	-99	-99	-99	-91	-11	-17
70	-38	-21	-49	-64	-24	-24	21	-47	-28	-22	-60	-8	-5	-15	-78	3	-38	-7	-73	2	-9	9	-63	-48
65	-98	-73	-78	-24	27	23	-27	-77	-48	-13	-13	-33	-99	-99	-98	-57	-99	-99	-99	-65	-56	-40	-54	-42
60	-99	-99	-90	-41	53	9	-39	-14	0	-34	-32	-61	-45	-99	-78	-99	-99	-99	-83	-49	-20	-42	-69	-99
55	-71	-99	-99	-97	-40	-91	-99	-66	-37	-99	-93	-99	-28	-31	41	-88	-99	-74	-19	53	18	18	-25	-6
50	-95	-11	-97	-99	-99	-81	-99	-99	-82	-99	-97	-99	-3	-78	-60	-99	-99	-99	-99	-99	-99	-99	-99	-74
45	-99	-85	-99	-99	-99	-99	-77	-54	-41	-99	-99	-99	-64	-99	-99	-99	-99	-99	-42	-51	-88	-99	-99	-99
40	-99	-99	-83	-49	3	-47	-67	-86	-78	-99	-65	-95	-99	-99	-82	-84	-72	-92	-69	21	-3	-65	-58	-76
35	-83	-46	-80	-71	-68	-52	-99	-58	-99	-72	-43	-59	-47	-84	-48	-39	-61	-97	-99	-49	-34	-25	-99	-90
30	-61	-35	-99	-58	-51	-25	-88	-93	-92	9	-9	-82	-59	-99	-86	-99	-90	-92	-83	-67	-92	-49	-99	8
25	-99	-30	-98	-71	-65	-70	-99	-99	-99	-99	-79	-99	-99	-99	-90	-99	-99	-99	-99	-99	-99	-26	-99	-79
20	-87	-44	-41	-59	-99	-99	-99	-97	-95	-99	-99	-99	-99	-63	-71	-75	-99	-34	-87	-71	-92	-60	-74	-99
15	-99	-67	-99	-66	-82	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-61	-99	-74	-99	-99	-99	-99
10	-98	-47	-99	-72	-76	-74	-79	-99	-99	-99	-99	-77	-99	-99	-99	-99	-99	-99	-63	-77	-99	-99	-97	-85
5	-99	-99	-82	-59	-82	-80	-99	-99	-99	-98	-99	-89	-99	-99	-99	-99	-99	-99	-80	-99	-99	-73	-29	-67
0	-99	-90	-93	-99	-99	-99	-99	-99	-99	-55	-90	-99	-99	-99	-99	-91	-39	-85	-64	-99	-99	-99	-99	-75
-5	-99	-55	-63	-99	-99	-99	-99	-99	-99	-99	-99	-95	-96	-94	-99	-94	-89	-99	-99	-64	-59	-99	-99	-99

TABLE 47 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
80	0	0	0	0	0	-37	-37	59	99	99	1	-99	43	39	99	-83	-83	-83	-83	-83	0	0	0	0
75	-99	-83	42	89	99	99	95	57	99	74	23	-54	99	34	99	-99	44	81	99	76	99	-99	-99	-99
70	-69	-27	11	31	-15	15	-29	28	73	66	60	11	99	-64	50	-62	14	26	14	-37	-53	-76	-79	-70
65	64	37	-36	-19	-99	-23	-78	26	63	67	72	47	-17	-38	59	47	65	44	-27	44	4	86	99	98
60	9	26	-69	-1	-99	16	-20	2	44	32	37	20	-69	-33	-4	1	5	90	27	99	-20	-14	-99	32
55	11	0	-51	-86	4	-92	-55	-61	17	-17	-1	-54	-68	-15	99	29	-28	-32	-99	11	-99	-86	-78	-38
50	-17	-99	-9	-12	99	-99	-7	4	42	-41	2	-3	42	5	97	6	88	-17	-53	-93	-84	0	71	-21
45	-27	0	-64	-55	-82	99	82	99	-7	12	-18	-48	-77	-92	-57	-99	-10	-29	53	7	24	21	54	-8
40	-15	92	-19	28	-99	76	9	88	-23	59	22	-24	-30	61	73	12	21	-4	-6	-55	-28	-2	99	69
35	-1	-13	36	77	59	-1	-23	-9	55	60	6	23	-61	49	-17	79	-5	11	4	16	-73	-69	18	34
30	33	3	66	78	99	87	99	46	20	7	46	48	25	50	14	62	9	72	21	29	-48	-43	26	44
25	50	-11	50	88	51	1	83	53	5	40	32	54	61	30	9	39	59	21	-55	-14	38	5	88	78
20	78	97	54	99	95	90	31	15	51	78	85	65	41	7	-14	81	44	52	9	71	99	75	51	96
15	80	99	51	66	79	63	37	-7	10	-26	17	18	35	68	16	99	42	84	8	9	-12	32	20	54
10	41	4	-12	-37	-5	-21	25	22	10	-25	-52	17	29	86	44	48	-26	-24	15	70	61	21	10	-32
5	-36	7	-1	52	6	-53	-29	4	10	-15	-2	-5	1	-62	2	39	65	-36	52	19	47	2	-16	-52
0	-27	43	-9	97	29	-39	-9	50	85	0	14	-15	-2	-25	-9	-33	41	-47	30	-29	8	33	20	33
-5	-53	-32	-99	55	99	68	59	18	13	-63	-68	-33	-49	20	22	29	44	45	62	8	17	17	15	30

TABLE 48
Corrections Applied to the PFKSZ

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	41	10	24	19	31	20	9	4	3	4	-8	-12	-29	15	44	60	54	55	40	34	15	-33	-2	1
85	32	5	6	-6	-9	-26	-26	-17	-2	-1	-11	-18	-18	0	25	20	22	3	-8	-24	-16	-13	22	8
80	4	16	5	-12	-9	-28	12	7	38	20	4	5	-4	-5	12	-14	-19	-32	-14	-24	-12	16	6	27
75	8	25	2	11	30	15	58	36	19	2	-12	13	-11	-7	7	19	19	2	8	6	-1	11	-15	33
70	30	31	5	16	28	37	38	29	18	15	1	18	-13	-10	-5	10	-1	4	-5	17	-3	0	-5	16
65	4	7	3	17	16	15	18	43	48	59	34	28	3	-2	11	-4	-14	-9	-26	-4	-18	10	16	6
60	29	12	9	24	18	29	16	48	27	25	20	26	19	-8	1	-24	-11	0	-4	10	-12	7	14	26
55	24	20	8	24	7	5	7	8	9	-18	4	-8	4	-12	19	-14	-5	-18	0	-15	-5	8	2	14
50	-19	-4	-13	11	-17	9	21	2	11	-7	16	24	-2	1	12	0	-9	-1	6	1	-1	-5	-12	-7
45	-13	12	2	38	-8	22	-15	-18	-1	7	12	25	-23	-15	-24	2	-25	5	-6	10	-9	-4	0	11
40	7	10	4	8	-9	4	5	13	14	3	6	8	3	8	-4	3	-5	-5	-1	-6	15	9	5	14
35	9	-12	11	7	11	-3	7	10	13	-3	8	-2	-11	-9	-5	-9	-11	-39	-9	0	46	-2	-10	-1
30	31	4	2	7	4	1	-11	-10	16	5	26	22	-3	-16	-20	-16	-5	-21	1	10	16	-17	-2	2
25	39	21	4	-9	-18	6	12	-1	18	-6	25	29	11	-16	-23	-20	-9	-8	9	15	24	-12	11	2
20	-2	11	9	7	-24	0	-3	-3	14	5	13	-2	-19	-23	-6	10	-8	2	5	17	7	-5	-9	-18
15	14	22	0	32	-21	-6	-42	-11	38	13	35	-1	-7	-17	10	27	3	17	3	19	-10	-2	-7	19
10	6	22	6	32	-11	-42	-16	6	38	-22	27	9	10	-13	8	-4	4	-7	-2	5	-22	-1	-4	21
5	-12	0	10	-10	2	-13	4	-10	-15	-28	-13	5	-3	-11	17	13	11	-13	-11	3	-5	29	6	-6
0	7	0	20	-19	-5	-19	6	-33	-15	7	12	10	-13	-21	-11	8	-6	-16	-7	27	9	22	-2	-20
-5	-16	-20	-1	-14	15	3	31	-39	-13	2	13	4	-20	-15	-17	6	0	0	17	10	-72	-63	-37	-46

TABLE 48 CONTINUED

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-38	-20	18	60	79	-2	-67	-80	-27	-7	8	5	5	-40	-18	-15	28	7	14	-3	-12	-50	-64	-68
85	0	21	24	19	1	-36	-55	-69	-17	-8	2	-17	0	-14	13	-25	23	1	-13	-49	-30	-27	22	-18
80	-3	-4	-23	-18	-43	-18	13	15	-9	-27	-11	-24	-15	3	22	-28	-12	-1	-9	-33	-12	-21	36	27
75	-70	-45	-21	22	-9	-14	8	-11	-16	-6	12	2	-54	18	11	16	-17	2	3	-15	7	-8	-19	-6
70	-46	-14	-1	22	16	11	33	5	23	21	35	39	11	-3	-17	21	-17	-8	-6	-31	1	14	14	-9
65	-15	11	-8	-8	-23	9	45	31	25	23	19	16	-9	-24	-17	32	-3	2	-15	-6	-24	-12	-15	-7
60	-14	10	6	39	-20	6	-1	-13	14	34	51	19	-33	-16	-5	15	21	27	20	14	4	5	12	9
55	-35	-11	1	25	-9	-10	-14	-28	-6	0	3	11	-6	0	8	-13	27	25	29	5	12	-13	-24	-20
50	-16	3	5	-26	-25	-2	18	37	10	0	-4	16	7	0	1	-24	54	50	31	35	11	-29	-9	-31
45	-14	27	40	1	-41	28	8	39	-15	-26	10	3	10	14	12	-24	-23	3	-2	8	-1	-21	25	-22
40	6	18	15	-24	-50	-12	-20	20	1	4	17	-15	-16	-1	13	-17	-24	-21	-15	4	2	4	11	2
35	29	-6	12	-11	26	4	12	-2	11	10	18	9	9	-9	6	13	24	3	-17	-1	-24	-20	-4	-18
30	4	-5	8	-8	18	1	-6	-10	-12	-4	7	24	10	6	20	17	-2	-37	-29	-9	-5	3	-2	-7
25	8	13	6	-9	-11	4	15	38	-5	-21	-19	5	2	12	48	-8	-14	-27	13	5	14	4	12	0
20	-11	-4	-4	5	26	0	3	20	8	10	1	12	-18	5	18	-10	14	-3	20	-3	10	-23	-23	-25
15	-5	2	-13	-5	5	18	24	17	16	-12	15	14	-5	5	-2	6	35	8	20	2	32	0	-18	12
10	11	3	1	-4	9	73	43	16	58	19	30	6	-4	63	30	32	-11	6	12	6	-7	-9	-9	21
5	-12	9	29	2	-7	-1	-34	-28	-12	18	-8	18	20	39	19	4	-21	5	6	-1	1	-13	-4	-14
0	-2	17	17	9	9	17	-10	-18	-38	-2	-18	-7	5	-36	-7	-4	8	3	18	24	37	20	6	21
-5	-27	-22	-13	8	37	35	19	-1	14	49	23	-21	-71	-99	-30	18	45	25	1	11	6	13	-22	6

TABLE 49
Corrections Applied to the Lund42 50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
75	-46	-10	16	37	37	37	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	24	17	1
70	-21	-24	3	12	28	13	0	0	0	-99	-99	-99	-99	-99	0	0	0	0	0	-6	-40	-27	-69	2
65	-3	-16	-6	-5	7	-11	0	0	0	-31	-31	-31	-31	-31	0	0	0	0	0	57	7	35	0	68
60	-15	-8	-23	4	4	28	99	99	0	51	51	51	51	51	0	0	0	0	0	87	39	62	26	51
55	-26	-22	-53	-27	-43	-8	-11	99	0	63	63	63	63	63	0	0	0	0	0	-6	-19	0	-6	17
50	-64	-37	-51	-71	-88	-85	-91	99	0	29	29	29	29	29	0	0	0	0	0	55	-5	1	-54	-28
45	-53	29	35	12	14	6	13	-51	0	29	-20	-20	-25	-25	-70	0	0	-67	-67	47	25	25	-31	-27
40	-44	6	-13	-87	-44	-58	-10	-51	0	80	-58	-58	-69	-69	-70	0	0	-67	-6	13	33	20	-43	-46
35	17	53	99	-76	-84	-99	-99	-99	0	90	-14	-14	-46	-46	-70	0	0	-67	2	-19	7	-51	-55	-39
30	-2	33	87	19	3	-73	-61	-60	99	99	69	69	53	53	-70	0	0	99	10	21	-45	8	-10	26
25	-42	-41	6	41	63	-26	-21	-32	-3	-13	-5	1	3	3	0	0	0	-45	-46	-26	-14	37	28	61
20	25	-76	-13	99	99	79	-81	-99	-98	-46	-33	-33	-33	-33	0	0	0	-85	-1	-14	58	21	66	22
15	-11	-96	0	99	91	67	-61	-93	-85	-13	25	33	48	38	0	0	0	-92	-65	-46	13	36	33	9
10	-62	-96	0	99	99	90	-17	-87	-42	-17	3	-24	-24	-74	0	0	0	-99	-91	-55	22	37	27	11
5	-76	0	0	99	72	-10	-60	-99	-59	-59	-37	-99	-99	-99	0	0	0	-99	-57	-27	39	10	6	-22
0	0	0	0	-99	-85	-86	-27	-7	99	48	37	-99	-99	-99	0	0	0	-88	-78	-46	4	35	59	56
-5	0	0	0	-99	-99	-99	-99	-66	99	98	94	-99	-99	-99	0	0	0	-88	-88	-88	-88	-88	0	0

TABLE 49 CONTINUED

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
75	99	99	99	99	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0	99	99	99	99	99
70	99	99	26	94	91	99	0	0	0	-46	-46	-46	-46	-46	0	0	0	0	0	-99	-63	-71	48	57
65	66	-20	-88	-99	-99	-71	0	0	0	-25	-25	-25	-25	-25	0	0	0	0	0	-99	-99	-99	3	-23
60	3	-66	7	1	47	62	99	99	0	-3	-3	-3	-3	-3	0	0	0	0	0	-99	38	7	86	-19
55	46	-36	-42	-21	32	99	99	99	0	-8	-8	-8	-8	-8	0	0	0	0	0	-99	-93	-44	23	73
50	92	45	-85	-99	-34	32	99	99	0	-29	-29	-29	-29	-29	0	0	0	0	0	-50	-99	-86	-90	58
45	2	-12	99	81	59	5	13	-48	0	-29	8	8	8	8	4	0	0	99	99	44	19	17	-5	-17
40	-45	-99	-99	-31	3	-21	-10	-48	0	99	43	43	16	16	4	0	0	99	98	23	-53	-78	13	-13
35	61	-74	-99	-41	-94	4	-7	71	0	81	88	88	51	51	4	0	0	99	85	54	-51	-94	-57	99
30	79	99	53	11	-51	37	35	99	91	7	-24	-24	-21	-21	4	0	0	99	99	99	99	58	-34	32
25	-84	99	99	99	8	-18	6	57	74	-21	-96	-99	-99	-99	0	0	0	-33	-38	-23	-20	6	-60	11
20	-75	99	99	88	39	11	48	43	25	4	-8	-20	-27	-27	0	0	0	99	74	87	22	85	53	99
15	91	99	0	-99	-52	-42	6	23	29	15	26	35	47	50	0	0	0	99	99	99	36	33	37	67
10	-99	99	-99	27	-2	99	33	28	41	42	48	-4	-4	-99	0	0	0	-99	-78	-52	5	5	-24	-45
5	-99	0	-99	-27	-99	99	-50	11	-18	33	28	74	74	99	0	0	0	49	99	99	99	66	66	35
0	0	0	-99	-31	-99	22	-43	99	94	88	27	-15	-15	-34	0	0	0	79	99	98	99	91	99	53
-5	0	0	0	99	99	99	99	99	99	99	99	-31	-31	-99	0	0	0	18	18	18	18	18	0	0

TABLE 50
Corrections Applied to the Cin 25

Right Ascension dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
75	-99	-99	99	99	99	0	0	0	0	0	0	13	13	13	13	13	0	0	0	-68	-68	-94	-99	-99
70	-33	-34	45	7	-39	-69	-82	0	32	32	11	2	-3	-21	-67	-99	-99	-99	-99	-91	-62	-58	-46	-40
65	-46	-56	9	30	-22	-49	-48	-14	45	22	14	-12	-15	-29	-42	-99	-99	-99	-70	-63	-42	-54	-38	-40
60	-75	-92	-34	11	-60	-79	-43	-38	-28	-37	-52	-99	-65	6	26	-20	-84	-88	-37	-31	-99	-91	-87	-56
55	-68	-99	-99	-68	-99	-83	-49	-56	-87	-68	-99	-99	-99	-40	-41	-71	-99	16	-23	-12	-85	-39	-20	1
50	-83	-99	-68	-35	-88	-68	-66	-12	-32	20	-72	-61	-96	-99	-99	-99	-99	-40	-22	-1	-40	-13	14	-10
45	-44	-88	-21	-97	-79	-99	-99	-68	-99	-75	-99	-73	-99	-99	-75	-65	-23	-99	-99	-99	-99	-99	-48	-40
40	-61	-96	-11	-99	-60	-99	-56	-57	-99	-44	-99	-27	-99	-61	-42	-73	-60	-99	-99	-99	-99	-99	-70	-97
35	-80	-25	57	-7	-21	-21	40	24	-50	-62	-99	34	56	70	-38	-99	-99	-99	-49	-77	-28	-6	-44	-50
30	-99	-99	-99	-99	-56	-67	-21	-79	-1	-80	-80	-34	-40	70	-38	-63	-50	-62	38	38	33	-35	-57	-34
25	-66	-99	-78	-60	-58	-78	-99	-99	-99	-99	-99	19	-24	-9	-83	-99	-78	-71	2	-10	-48	-30	-56	-80
20	-8	-3	99	98	7	-84	-99	-62	-99	-80	-99	-28	-99	-85	-99	-99	-99	-76	-14	-45	-67	-62	-66	-85
15	-35	-53	-47	-56	-63	-65	-99	-76	-51	-77	-40	-99	-99	-99	-71	-53	-46	-14	-42	-27	-51	-4	-37	-49
10	-86	-99	-99	-99	-99	-92	-95	-99	-84	-99	-97	-99	-99	-91	-37	-26	-99	-99	-99	-76	-61	-13	-62	-54
5	-63	-89	-40	-64	90	-24	-99	-99	-99	-99	-99	-83	-52	-35	-99	-99	-99	-94	-99	-21	-7	-35	-75	-99
0	-43	-99	-57	-46	34	8	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-1	48	51	-41	-99	-99	-83	-99
-5	-69	-99	-36	-56	-6	-33	-74	-99	-99	-99	-62	-99	-99	-99	-99	-9	22	-15	20	45	-50	-63	31	-75

TABLE 50 CONTINUED

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
75	99	99	99	99	99	0	0	0	0	0	0	-39	-39	-39	-39	-39	0	0	0	-99	-99	15	99	99
70	43	-26	99	44	-87	-99	-99	0	89	89	62	27	20	-6	-4	9	36	63	-6	-66	-99	-9	53	55
65	-17	-42	94	-50	-1	-98	11	17	99	53	49	4	23	7	29	41	33	37	-42	-25	-69	45	47	30
60	-13	58	47	-65	99	-10	99	4	-19	-43	4	-24	-15	-57	10	28	20	52	-12	33	-47	28	-30	38
55	46	64	32	-13	-26	20	56	-15	-59	-24	10	99	45	-51	-93	-62	-60	94	5	43	-61	72	81	99
50	-4	-89	-43	26	-53	-28	-15	-48	-53	-9	-35	34	99	52	28	28	-7	91	43	99	99	99	99	98
45	18	61	72	29	-38	-99	-39	-97	30	-2	26	-5	22	20	51	39	83	84	-8	15	50	56	9	-19
40	61	25	76	13	8	-77	10	-46	99	-13	89	7	23	45	69	-10	46	99	73	89	62	19	-44	-96
35	6	-64	-41	-57	51	5	52	-2	-26	-92	12	32	28	-23	11	-99	12	-17	-16	8	99	99	87	79
30	-48	-14	32	30	35	-85	-21	33	98	49	38	-16	1	1	-8	-4	34	-52	-94	-99	-45	57	9	43
25	-42	-99	2	52	47	13	-33	32	-18	18	-41	1	35	99	87	6	-19	-61	-68	-99	-93	-14	-10	-57
20	31	2	53	99	99	77	-21	-27	-52	33	-4	56	-48	14	12	-32	-49	-42	16	66	44	99	60	-4
15	90	-31	70	52	99	6	55	-26	99	79	72	-67	-39	15	49	99	99	99	61	62	5	38	31	7
10	11	-99	-14	-6	99	-96	-73	-99	-51	-99	99	-23	75	-5	28	3	41	50	62	68	1	28	6	-4
5	-39	44	81	99	99	58	-13	-4	-53	-99	85	-23	62	-80	-9	19	59	8	45	41	36	18	45	99
0	-55	0	-1	17	99	99	25	-11	-8	-99	-85	-99	10	-13	-28	-44	-13	-71	-7	-36	-21	-59	-75	-27
-5	13	6	-22	-62	48	68	99	-99	99	99	99	-1	9	21	-69	86	91	99	4	-26	-99	-99	-99	-27

TABLE 51

Corrections Applied to the Moscow40 50

dec\ra (Right Ascension)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	45	-4	40	36	99	99	73	49	-32	-99	-99	-99	-58	27	54	69	40	-2	-87	-88	-53	-99	-99	-99
85	29	-2	-5	-16	1	-16	10	24	1	-46	-74	-57	-42	-1	11	18	25	13	-32	-52	-19	-24	-44	-87
80	46	23	-9	-40	-69	-13	20	42	28	-13	-7	16	-3	-27	-28	-38	-16	-13	-19	-29	22	6	-27	16
75	28	36	15	-15	-31	42	66	63	59	20	11	45	-13	-34	-34	0	-8	0	-15	11	25	-10	-59	8
70	-5	43	9	-11	-31	1	14	-5	29	21	1	45	-17	8	-32	50	20	68	11	-18	-43	-21	-39	13
65	-47	2	-24	-25	-27	33	46	37	76	65	10	40	-16	15	-55	12	-63	10	-68	-56	-39	-4	15	6
60	7	42	8	-12	-26	-20	41	59	70	80	39	59	26	5	-49	-77	-95	6	-15	-48	-70	-31	2	23
55	-3	44	21	54	-20	-67	25	18	-47	-40	-99	-55	-57	-33	-8	7	10	-1	-45	-35	-47	-1	-38	-3
50	-51	-11	11	21	-10	-32	12	61	-5	-80	-99	-56	-16	-37	-5	-22	-63	-82	-73	27	14	36	1	37
45	-10	3	19	-20	-81	-99	-86	13	-14	1	2	-35	-7	-50	6	-44	-17	-63	-39	-50	-14	-7	43	82
40	17	22	54	-17	-50	-28	-37	48	22	30	-1	-21	10	10	59	10	-1	-34	3	12	35	-2	49	88
35	-43	-11	14	33	19	-13	-63	-11	33	-30	-43	-47	15	-32	29	2	-27	-39	-14	1	39	6	-30	1
30	18	-19	-40	-60	-48	-26	-6	0	15	-13	16	21	8	-14	-8	0	4	-9	-28	-50	-36	-13	7	25
25	97	84	-18	-60	-92	5	-12	20	18	1	-15	4	-17	-18	8	-46	-57	-13	35	22	5	21	47	64
20	31	38	-1	28	12	99	-44	23	-24	70	-10	40	13	32	31	-6	-71	-21	58	17	-18	-29	-24	20
15	10	3	4	-15	-54	8	-99	0	-85	65	15	-11	-2	-24	12	47	21	97	-2	6	-21	2	-24	-6
10	16	29	40	46	-4	67	-42	45	-99	-55	-33	-37	3	-26	24	16	21	72	-50	-19	-48	28	-3	46
5	-65	-2	-63	-9	-25	45	-8	42	-65	-99	-58	-40	-8	10	55	29	9	11	-30	-8	-35	34	-12	64
0	26	24	46	52	54	44	-5	23	-56	-99	-99	-99	-81	-42	-29	6	3	10	-21	13	-4	59	38	82
-5	99	47	90	79	85	2	-59	-66	-86	-99	-99	0	-99	-55	-55	1	1	26	-40	14	17	80	92	99

TABLE 51 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-25	-33	43	99	99	99	30	-99	-38	-19	34	1	-57	-74	5	36	12	-15	-18	-13	9	-17	-41	-13
85	24	76	64	80	91	42	36	4	-8	5	10	12	-16	-10	24	-16	2	-1	-7	-9	-30	-87	-69	5
80	13	61	17	25	-7	1	20	76	11	21	-14	5	0	0	32	-51	-23	1	-57	-16	-22	-10	-25	14
75	-63	-26	-10	26	-5	-27	-31	-14	-33	-8	-22	-87	-99	-89	-7	-24	-32	8	-23	4	19	9	6	-5
70	-3	65	13	39	19	14	42	33	5	-9	1	9	-11	41	31	36	-29	-14	-26	-53	-36	-18	56	39
65	-22	89	57	72	16	12	2	45	77	26	31	14	-22	-6	-25	33	-5	0	-63	-70	-29	-11	4	-11
60	-5	52	45	57	9	2	-35	33	60	45	25	24	-17	-60	-54	-16	23	28	0	-10	23	-12	-31	-32
55	-15	-14	-40	-7	-58	8	42	96	31	30	-20	22	13	-16	-10	2	24	41	38	28	-4	11	10	-19
50	-37	5	-2	-5	-73	-79	-14	13	36	34	18	36	2	13	1	6	-52	-25	-16	-50	-9	-15	19	-9
45	-38	41	77	17	-33	-75	49	61	99	84	21	-9	-75	-2	-30	-19	-20	-24	-4	-72	16	7	44	-6
40	-29	-16	-82	-19	-99	-12	-31	10	-4	29	-5	-22	-49	-1	-23	15	26	34	19	9	16	9	28	-21
35	15	-10	-8	-21	-1	44	-13	-29	-41	-28	-10	7	4	33	-42	-41	-20	-13	-33	-28	-16	-6	-4	-27
30	27	8	0	-50	80	11	6	-53	-20	6	8	13	-3	88	30	24	-11	-62	-35	-30	-19	17	-21	11
25	-8	46	-67	12	7	-7	-29	7	41	77	44	2	-2	60	22	59	78	38	30	7	-14	34	14	78
20	-99	-17	-61	67	29	25	-4	39	92	64	82	-17	-24	-40	-3	-16	43	-30	-32	-17	34	25	3	-2
15	-52	18	-25	-10	-18	-14	-18	4	53	17	31	-19	-43	-19	52	1	57	-19	29	12	40	17	-8	16
10	-48	-6	-41	-18	-2	28	59	57	53	43	-53	11	-49	-11	4	20	-2	-24	-12	-44	-13	-2	-9	-8
5	-59	15	-57	-73	-70	-91	-58	-99	-54	-41	-61	17	8	24	6	-33	-25	-18	27	-21	4	-42	14	-26
0	-7	47	-20	-53	-11	-66	-10	-99	-32	12	62	22	32	9	14	-43	-47	-79	15	-2	55	0	62	21
-5	99	99	45	-39	25	64	99	99	99	99	99	99	99	15	15	-43	-43	-69	39	35	85	99	99	99

TABLE 52
Corrections Applied to the Tri 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	43	43	0	0	0	0
30	56	56	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	43	43	0	-68	-68	-68
25	70	42	-6	-23	67	99	99	99	84	99	-3	-99	-99	-99	64	99	57	99	99	99	-7	99	99	99
20	-59	49	54	-21	53	37	-7	-16	-4	-32	-61	20	42	-54	10	-36	4	-4	-6	35	-1	-46	15	-18
15	-25	31	26	-23	-19	-21	-22	-9	50	10	-68	-24	49	-9	-25	-12	-18	23	-42	-18	33	-8	-21	9
10	-63	-15	38	-9	-53	-22	8	6	-9	-38	-71	15	-3	-99	-4	-34	-23	15	-27	-65	-4	-17	-9	20
5	-18	9	13	-41	-9	20	-39	-25	-17	-1	-59	49	-36	-52	-17	4	-99	-22	20	42	15	-29	-32	-35
0	48	-99	-1	-19	17	-39	-67	-60	-37	-37	-99	-17	-35	32	-7	-17	61	-5	-99	-33	-99	7	-35	-13
-5	0	0	0	0	99	99	99	99	0	0	0	99	99	34	99	99	99	99	99	99	99	99	99	99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	96	0	0	0	0
30	99	99	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	96	0	-99	-99	-99
25	7	99	13	-70	99	-77	-93	99	77	12	-99	-99	99	99	-99	99	99	-37	99	99	99	99	5	-99
20	-20	-18	-38	-39	60	-11	-36	-32	-2	-54	-53	-30	-54	9	30	-5	-34	-73	-80	59	39	-99	-80	-17
15	-10	-99	35	-46	58	27	57	-31	10	25	-44	-52	3	16	97	-17	-21	22	26	-27	-19	-38	-60	25
10	57	-14	73	-52	63	68	10	-10	52	16	-89	58	75	-8	-2	83	29	-36	-19	62	99	-50	-39	62
5	34	-2	95	12	93	99	86	48	87	37	55	12	83	29	75	99	21	99	53	32	99	57	1	99
0	99	-85	-68	-45	86	-56	21	80	32	15	56	15	33	99	99	39	-2	99	5	99	99	26	0	99
-5	0	0	0	0	-23	70	99	99	0	0	0	-99	-99	-99	59	99	-99	-99	-99	-99	-99	-99	-99	-99

TABLE 53
Corrections Applied to the Bruss 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	0	16	16	-1	-20	18	42	52	55	55	0	-32	-32	-32	-32	-36	-99	-13	-7	-5	-5	-5
85	-44	-99	0	16	16	-3	-18	-4	21	38	39	39	-38	-66	-27	-40	21	-62	-40	-45	-18	-13	-14	-15
80	-61	-99	-9	0	-9	-17	-22	-9	6	26	4	5	-35	-99	-10	-99	22	-99	-43	-83	-56	-84	-63	-76
75	-81	-99	-45	-41	-16	-20	-19	2	6	13	-2	11	6	41	14	-1	-24	-42	-22	-44	-56	-99	-73	-98
70	-99	-99	-80	-56	-27	-21	-5	31	2	-7	7	22	34	25	-2	-2	-17	25	96	61	61	-20	-44	-99
65	-67	-54	-34	-21	7	-29	-20	-18	12	7	13	0	18	-7	-28	-61	-62	-89	-83	-78	-7	-35	-40	-49
60	-29	-26	-47	-40	-24	-40	-27	-29	13	-14	-4	-67	-40	-48	-34	-19	-34	-59	-99	-99	-99	-90	-42	-42
55	-45	-53	-99	-60	-99	-28	-42	-26	-24	-19	-31	-69	-23	-37	-50	-54	-61	-35	-37	-56	-69	-79	-26	-57
50	-45	-8	-51	-34	-99	-13	-57	-8	-62	-23	-40	-77	7	-87	-57	-95	-70	-52	-52	-53	-51	-54	-49	-55
45	-61	2	-26	-44	-94	-69	-85	3	-80	-99	-77	-99	-32	-99	-57	-99	-15	-42	-42	-71	-70	-66	-67	-58
40	-61	-19	-27	-34	-39	-77	-97	-41	-35	-98	-99	-99	-70	-85	-70	-84	-32	-96	-24	-95	-91	-95	-81	-62
35	-61	-40	-54	-33	-58	-60	-85	-91	-66	-98	-99	-91	-97	-82	-99	-88	-91	-99	-41	-99	-59	-84	-66	-67
30	-36	-37	-54	-26	-99	-71	-85	-85	-38	-45	-59	-62	-99	-97	-99	-72	-78	-86	-64	-98	-78	-93	-74	-82
25	-61	-68	-65	-75	-99	-99	-88	-99	-55	-99	-99	-99	-90	-91	-99	-99	-99	-61	-61	-24	-76	-80	-73	-68
20	-99	-99	-51	-99	-77	-99	-97	-96	-83	-91	-99	-96	-79	-79	-99	-99	-99	-72	-94	-48	-94	-76	-89	-85
15	-68	-99	-58	-61	-24	-76	-82	-96	-44	-59	-44	-91	-98	-59	-65	-41	-75	-45	-70	-95	-83	-60	-55	-57
10	-67	-91	-70	-70	-32	-61	-72	-99	-73	-99	-62	-99	-93	-73	-70	-73	-89	-55	-31	-99	-29	-59	-58	-99
5	-77	-82	-43	-50	-71	-71	-74	-59	-51	-85	-74	-94	-90	-90	-84	-87	-75	-91	-62	-78	-25	-41	-58	-99
0	-59	-68	-64	-79	-99	-99	-99	0	-99	-93	-93	-76	-71	-66	-57	-62	-37	-95	-78	-99	-52	-53	-46	-87
-5	-99	-99	-99	-99	-99	-99	-99	0	0	-69	-69	-99	-99	-99	-99	-99	99	-99	-99	-99	-99	-99	29	-99

TABLE 53 CONTINUED

Declination dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	0	-50	-50	-37	-19	-24	-34	-40	-43	-43	0	34	34	34	34	38	99	-45	-54	-56	-57	-57
85	5	-75	0	-50	-50	-36	-22	3	18	25	17	17	-99	24	25	27	31	36	22	-7	-34	-45	-45	-45
80	0	-99	99	36	3	-22	-28	6	7	15	-35	-37	-99	-86	-50	-15	10	32	5	30	33	57	36	28
75	-38	-99	1	8	60	-3	-46	-44	-29	-7	-42	-61	-99	-25	-47	-20	-63	34	1	48	43	95	44	6
70	-59	-99	-49	-53	57	33	-31	-77	-22	24	-55	-57	-53	-30	-53	-61	-84	-30	-99	-32	-49	42	-43	-99
65	90	11	-43	-74	18	34	37	18	16	-22	-59	6	50	85	22	-20	-5	14	5	-8	-24	59	51	37
60	68	-7	-70	-60	18	21	27	12	45	30	-7	44	81	99	99	74	77	28	31	20	37	64	62	96
55	-57	-62	-73	-39	14	25	-1	-17	-12	9	-6	-1	52	27	52	-38	18	-18	6	8	55	61	27	34
50	-81	-10	9	23	50	25	19	3	60	38	14	-17	46	39	53	-18	11	-33	-18	-16	56	53	25	-14
45	-65	-72	-15	36	58	32	75	69	92	-5	-27	-31	2	-25	-21	-4	4	29	13	5	54	45	33	-18
40	-99	-99	-48	24	-18	14	41	50	-41	-48	-40	9	67	-25	-7	2	-6	31	-43	20	58	57	38	-32
35	-98	-97	-42	63	-41	8	5	53	34	28	3	62	76	11	-21	27	-6	31	-24	29	14	19	17	-14
30	71	12	-18	31	-10	26	12	5	43	33	-6	48	-9	32	-61	19	3	32	7	32	29	66	94	89
25	-6	37	17	-8	-9	8	32	-16	62	89	-20	-17	-86	-4	-67	-7	-13	11	-10	-25	-13	-10	-41	-70
20	-95	-44	-32	-57	-18	-18	1	-20	-23	-28	-45	-3	-37	-1	-55	-15	-25	17	-14	-56	-50	-37	-49	-98
15	2	15	-27	-80	-75	-61	-52	-39	-11	-73	-35	34	20	-6	-40	0	-11	4	-12	-25	-29	11	12	25
10	-76	-25	18	22	13	-4	-25	-54	-31	-88	-41	55	9	-46	-85	-69	-67	-7	19	-12	-52	-34	-34	-70
5	-23	-47	18	-16	9	3	-24	-99	-94	-55	-35	2	-27	-46	-55	-95	-99	16	27	-7	-50	2	12	-58
0	50	15	-15	-78	-55	-55	-39	0	99	-33	-33	-17	11	33	16	-11	-99	28	7	25	-24	28	47	22
-5	93	93	-27	-67	-87	-87	-87	0	0	-50	-50	23	99	99	99	99	-77	99	99	99	87	87	-65	93

TABLE 54
Corrections Applied to the Leid21 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
55	-86	99	99	25	-33	-71	-28	0	0	0	0	0	0	0	0	0	0	-28	-45	-92	-83	82	-19	-96
50	5	-51	-58	-42	-67	-85	-99	-1	99	0	99	99	17	-99	-99	-83	13	-55	-50	-37	-37	-74	-98	-50
45	-48	-9	-53	-92	-55	-71	-99	-76	-18	-17	-99	-99	-99	-92	-75	-79	-72	-99	-61	-30	-62	-69	-78	-99
40	-75	-38	-88	-70	-83	-70	-48	-99	-99	-99	-98	32	-23	-90	-46	-72	-36	-43	-92	-34	-99	-40	-25	-88
35	-80	-75	-86	-96	-99	-68	-99	-99	-82	-50	-34	-95	-93	-75	-84	-99	-99	-99	-99	-73	-97	-68	-78	-91
30	-71	-46	-37	-62	-63	-37	-95	-99	-99	-99	-52	-52	-31	41	1	-99	-99	-99	-54	-61	-51	-53	-12	-56
25	-99	-99	-71	-91	-90	-99	-16	-91	-80	-2	-52	-52	-86	-99	-99	-94	-38	-99	-99	-99	-44	-44	-96	-99
20	11	-6	-77	-99	-60	-83	-99	-99	-80	0	0	0	-99	-10	-99	-87	-90	-99	-97	-99	-99	-73	11	-8
15	-15	99	-18	-70	-77	-63	-87	-99	-92	-99	-72	-52	-45	-93	-99	-99	-86	-71	-21	-26	0	-68	-24	-34
10	-34	-33	-55	-83	-63	-68	-78	-61	-99	-99	-84	-58	-66	-99	-59	-61	-82	-40	-23	-61	-85	-93	-99	-42
5	-84	-65	-57	-52	-57	-70	-99	-47	-99	-99	-56	-72	-99	-99	-98	-99	-99	-99	-99	-68	-2	-52	-37	-90
0	-18	-28	-99	-81	-99	-99	-99	-81	-81	-94	-99	-99	-96	-99	-87	-37	-25	-53	-92	-99	-99	-99	-99	16
-5	0	0	-99	-99	-99	-99	-99	-99	-99	-99	0	0	11	-99	-99	-99	-82	-79	-87	-99	-99	-71	-41	-24

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
55	99	99	25	-15	99	80	-99	0	0	0	0	0	0	0	0	0	0	35	62	99	99	34	-5	99
50	-6	73	20	1	77	99	99	99	99	0	0	0	-66	77	99	78	-26	27	55	94	20	6	43	-10
45	47	79	65	46	59	70	36	99	99	19	87	71	45	40	99	99	82	48	34	49	-4	41	99	51
40	45	38	58	27	26	55	39	84	98	-17	79	99	99	93	8	99	99	42	-1	43	46	71	51	61
35	-18	48	46	-2	-6	47	-6	-21	31	55	66	44	36	70	73	74	-44	4	32	32	40	47	96	48
30	-4	-35	66	62	72	99	-2	4	38	62	2	2	-1	-27	-80	11	22	13	25	20	31	54	5	30
25	16	-28	-87	99	96	14	20	99	31	-99	2	2	36	84	99	99	48	10	99	99	24	20	94	13
20	72	86	60	99	67	40	-26	-38	-26	0	0	0	85	17	57	27	-33	-25	42	79	84	44	27	20
15	49	1	23	25	50	99	44	18	99	99	99	99	99	99	99	70	67	71	50	51	83	48	43	69
10	29	12	28	36	27	-14	45	43	27	41	92	99	55	20	12	20	24	82	90	51	26	72	99	40
5	83	64	45	51	93	99	-26	29	67	-33	45	-3	2	21	13	93	65	-75	-15	78	19	45	14	52
0	-13	-16	-24	-18	23	19	16	99	99	99	0	-49	-58	31	56	27	-24	-30	77	48	32	35	22	-32
-5	0	0	-99	-99	-2	16	16	-99	-99	-99	0	0	-45	10	9	-47	-99	-11	-16	-36	51	90	-14	-99

TABLE 55
Corrections Applied to the Leid24 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	-65	-62	-62	-68	-77	-85	-68	-80	-80	-82	-67	-62	-82	-87	-99	-94	-85	-59	-59	-63	-73	-74	-76	-69
45	-70	-71	-70	-73	-77	-85	-68	-83	-87	-87	-72	-67	-81	-81	-97	-89	-86	-59	-59	-65	-71	-74	-75	-72
40	-76	-77	-77	-75	-77	-85	-68	-90	-93	-93	-80	-70	-80	-76	-91	-84	-83	-58	-59	-65	-70	-75	-75	-77
35	-86	-71	-70	-72	-90	-97	-17	-99	-93	-97	-93	-89	-93	-93	-96	-97	-99	-99	-99	-91	-99	-94	-15	-21
30	-86	-71	-71	-74	-94	-99	-19	-99	-93	-97	-93	-86	-94	-94	-97	-92	-99	-98	-99	-88	-96	-93	-14	-21
25	-85	-71	-71	-76	-98	-99	-20	-99	-93	-97	-93	-83	-95	-94	-94	-89	-93	-92	-99	-84	-93	-91	-13	-20
20	-69	-46	-40	-33	-35	-39	-99	-99	-99	-90	-86	-89	-80	-81	-85	-84	-85	-66	-50	-32	-49	-59	-99	-33
15	-76	-49	-41	-33	-33	-35	-99	-99	-99	-85	-80	-84	-69	-74	-80	-87	-85	-66	-55	-40	-62	-67	-99	-40
10	-80	-53	-41	-33	-34	-38	-99	-99	-99	-77	-72	-74	-55	-65	-76	-90	-86	-67	-58	-45	-72	-74	-99	-46
5	-79	-58	-76	-45	-81	-81	-76	-99	-99	-99	-99	-99	-83	-76	-86	-79	-89	-74	-73	-75	-27	-31	-99	-81
0	-70	-46	-68	-48	-81	-83	-77	-99	-99	-99	-99	-99	-83	-75	-85	-76	-83	-70	-71	-67	-18	-22	-99	-74
-5	-61	-38	-62	-50	-80	-80	-72	-99	-98	-99	-99	-99	-82	-74	-83	-71	-79	-68	-69	-62	-13	-14	-99	-68

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	17	0	8	32	61	60	39	47	55	90	64	53	45	58	91	65	64	41	47	47	49	51	59	36
45	27	15	20	43	62	61	39	46	54	87	63	50	42	50	83	58	60	39	43	40	44	48	61	46
40	34	28	31	50	63	62	38	46	52	82	62	48	38	40	70	45	55	35	39	36	39	46	63	52
35	31	41	34	50	47	67	8	32	13	19	17	36	35	37	48	54	32	7	8	6	11	7	19	9
30	33	43	36	52	51	73	14	32	15	23	23	40	39	36	50	60	35	5	-2	-3	4	5	18	13
25	34	43	36	54	56	79	19	34	17	25	32	44	42	35	53	66	45	8	-11	-11	0	2	17	18
20	-2	32	51	69	64	36	91	90	99	85	69	65	42	46	50	38	33	34	33	37	23	41	49	12
15	-4	30	51	73	70	42	94	87	99	77	63	59	37	41	48	42	38	40	36	42	31	55	68	19
10	-7	28	52	73	70	44	91	77	87	69	55	50	27	36	45	48	45	47	40	47	38	64	80	25
5	-1	-1	11	20	22	8	7	-5	14	8	34	22	21	29	46	50	25	6	4	7	16	21	26	0
0	20	16	23	26	25	10	9	0	21	13	34	24	21	26	38	43	18	5	5	7	14	18	30	12
-5	31	28	32	30	26	8	11	7	29	19	35	25	22	22	29	30	9	3	5	7	12	15	35	20

TABLE 56
Corrections Applied to the Lund 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
45	-12	-21	-83	-61	18	-71	-99	-99	-90	-99	-99	-88	-99	-99	99	-99	-99	-99	-99	-99	-99	-99	-51	-37
40	-91	-85	-72	-94	-93	-99	-99	-99	-99	-99	-99	-99	-81	-99	-88	-99	-99	-99	-99	-90	-99	-84	-89	-77
35	-88	-98	-63	-60	-95	-95	-95	-99	-99	-99	-99	-99	-99	-97	-86	-99	-99	-99	-99	-99	-71	-48	-99	-94
30	-99	-99	99	-8	70	71	-68	-99	-99	-99	-99	-53	-99	-73	-99	-99	-99	-99	-99	-54	-65	18	-99	-99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
45	70	99	-36	-23	-16	-55	-26	81	35	-68	92	99	99	99	99	99	99	99	-99	-99	-66	22	99	11
40	27	8	-17	7	-19	-22	-21	2	12	1	8	1	-5	-8	51	22	4	44	-5	-35	11	8	27	27
35	17	-33	-12	8	17	-30	-28	-32	-16	-14	-13	-13	-22	-37	-20	-34	-23	-9	-41	-32	-2	-18	-34	9
30	39	-99	-99	-87	99	-4	78	32	-99	-61	30	99	-43	-99	-15	99	25	-99	-99	-1	71	-23	-93	99

TABLE 57
Corrections Applied to the Leid27 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	-79	-38	3	-47	-64	-82	-99	-98	-77	-58	-41	-30	-15	-42	-30	-37	-8	-65	-45	-8	54	-3	-99	-97
60	-57	-48	-29	-62	-83	-94	-90	-77	-54	-63	-55	-54	-43	-60	-55	-65	-47	-95	-71	-32	1	-2	-67	-60
55	-44	-50	-53	-67	-87	-97	-72	-62	-46	-72	-66	-63	-56	-64	-64	-77	-78	-99	-94	-62	-52	-28	-53	-39
50	-42	-34	-45	-37	-62	-72	-40	-36	-41	-80	-84	-70	-69	-65	-71	-84	-99	-99	-99	-99	-99	-95	-71	-41

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
65	40	30	-86	-90	-87	-40	32	67	59	2	-61	-10	36	97	52	40	98	36	44	21	-12	5	-8	77
60	43	6	-6	8	-44	-13	-6	12	17	9	-34	1	26	53	30	17	53	0	21	-4	9	25	35	85
55	41	-17	34	61	-9	4	-35	-29	-11	18	0	16	21	39	35	29	38	-7	8	-27	22	30	74	83
50	37	-92	43	99	40	2	-90	-99	-45	30	37	31	14	32	49	54	38	3	-7	-74	33	26	99	81

TABLE 58

Corrections Applied to the Berl Z 10

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-23	-10	29	49	21	-37	-39	-25	-35	-79	-66	-36	34	18	32	34	31	40	24	18	0	-13	-3	9
85	-15	-5	3	2	-2	-7	0	13	4	11	21	20	53	53	38	24	22	16	10	-1	-16	-29	-12	-5
80	-11	-5	-11	-11	-2	3	13	4	-9	20	24	14	18	32	12	1	6	-6	3	12	15	-6	-1	-13
75	-30	-36	-27	-7	7	3	12	-42	-51	-2	3	-18	-31	-9	-6	-6	10	-5	28	54	73	30	3	-28
70	0	0	0	0	0	0	0	0	0	0	15	15	15	15	15	0	0	0	0	0	0	0	0	0

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	-66	-79	-24	-8	57	59	63	34	58	17	13	-20	53	22	-7	-33	-39	14	-8	43	-23	-8	-41	-53
85	-55	-17	-20	-35	-23	-19	-4	-25	-13	-49	-23	-12	0	-28	-32	-38	-27	-40	-31	-14	-40	-35	-65	-48
80	-29	-1	-31	-39	-60	-33	8	28	8	-66	-54	0	-5	-9	-25	-22	-3	-75	-10	-17	-1	-10	-40	-4
75	-3	7	-22	14	-25	25	99	99	84	-78	-99	-15	-22	9	-35	-18	1	-64	38	-1	23	1	-36	44
70	0	0	0	0	0	0	0	0	0	0	99	99	99	99	99	0	0	0	0	0	0	0	0	0

TABLE 59

Corrections Applied to the Kon19 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	-99	-6	-6	-99	-99	-99	-49	-31	0	0	0	0	0	0	0	0	0	-99	-99	-99	-99	-99	-99	-99
55	-23	-42	-78	-40	-96	-46	-72	-68	-93	-69	-99	-21	-91	-87	-86	-71	-77	-89	-92	-99	-99	-41	-99	-99
50	29	-42	-75	-99	-66	13	-28	10	11	-7	-45	32	-61	-99	-97	-99	-83	-21	-61	-88	-62	-4	-64	-38
45	0	0	0	0	0	-83	-83	-83	0	0	0	66	66	66	0	33	62	99	38	12	0	0	0	0

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	99	-99	-99	10	-7	15	99	99	0	0	0	0	0	0	0	0	0	-25	2	-1	-99	-99	-99	99
55	53	-33	53	85	40	33	28	40	13	-36	-93	-28	15	17	29	-7	-31	11	42	33	25	-19	-41	48
50	22	-3	25	39	41	81	80	39	14	84	67	-13	45	34	38	65	99	82	46	96	71	23	42	31
45	0	0	0	0	0	99	99	99	0	0	0	-1	-1	-1	0	99	99	99	-99	-99	0	0	0	0

TABLE 60

Corrections Applied to the Toul3 00-II

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	-55	-65	-49	-49	-17	41	41	-99	-99	-99	-99	-99	-99	-99	-99	-71	33	-61	-93	-40	99	-99	-99	-99
15	-41	-36	-15	-79	-59	-80	-87	-99	-99	-99	-99	-99	-99	-99	-99	-99	-69	-99	-99	-76	-73	-99	-99	-99
10	-84	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-87	-99	-99	-60	-73	-99	-99	-99
5	-75	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-66	-99	-99
0	-10	22	10	-23	-96	-99	-99	-99	-99	-99	-70	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-42	-85	-72
-5	-18	-4	-19	68	-39	-99	-99	-72	56	12	-55	-99	-99	-99	-99	6	40	39	-99	-99	-99	-99	-99	47

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	22	-99	-25	-25	58	41	41	41	81	99	-99	99	99	99	48	-75	-99	-33	37	80	84	99	99	99
15	28	-53	-20	21	45	89	5	16	-88	-27	-99	-37	-52	15	-20	47	36	72	40	64	12	16	-9	58
10	22	-26	18	9	18	8	-16	15	-13	44	4	-3	-22	-6	-12	33	12	20	-38	-24	-29	-13	-13	2
5	46	4	23	-21	-3	28	15	38	16	20	16	-16	6	-20	15	7	8	-6	-53	-24	11	-13	5	-27
0	76	21	-27	-47	-25	70	86	99	-21	-74	-93	-86	-18	-37	50	29	60	24	-12	32	61	-2	29	-20
-5	-99	-99	-88	-23	11	99	99	99	-99	-99	-99	-13	99	99	99	99	99	99	-69	49	99	99	-10	-99

TABLE 61

Corrections Applied to the Pulk 10

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	-68	-99	-49	-38	-11	-2	-47	-81	-99	-99	-99	-99	-99	-27	58	59	5	-99	-99	-16	-9	41	-5	-44
45	-61	-58	-62	-77	-80	-55	-99	-95	-66	-65	-99	-68	-99	-87	-74	-70	-59	-73	-61	-68	-84	-54	-58	-75
40	-37	-42	-75	-59	-84	-85	-77	-69	-87	-84	-85	-89	-88	-65	-47	-82	-99	-99	-97	-74	-68	-73	-65	-29
35	-99	-99	-34	80	50	3	-99	-99	-99	-74	-51	-63	-37	-59	-99	-99	-99	-99	-99	23	79	49	99	99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
50	87	75	19	9	73	71	77	40	-22	18	15	9	-11	-73	7	20	20	56	96	58	-3	-17	-38	12
45	19	47	33	11	18	38	-7	9	20	33	11	5	31	17	22	12	15	32	8	17	22	42	22	21
40	54	45	27	44	35	36	50	28	19	54	36	39	54	56	51	54	33	6	2	48	35	5	34	63
35	99	63	-13	-87	-99	-13	99	-13	-74	20	28	23	-64	-52	50	99	99	39	0	30	99	99	66	93

TABLE 62
Corrections Applied to the Lick 17

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	-67	-62	-44	-15	-5	-27	-47	-89	-45	-53	-7	-20	-16	-9	-32	-64	-64	-53	-72	-24	-30	-37	-80	-51
55	-65	-73	-57	-35	-26	-52	-60	-89	-50	-51	-15	-30	-38	-34	-56	-64	-56	-43	-62	-32	-42	-51	-73	-53
50	-60	-77	-59	-43	-30	-60	-67	-84	-56	-49	-32	-37	-47	-43	-73	-66	-52	-45	-67	-70	-74	-78	-59	-56
45	-47	-65	-44	-24	-6	-51	-64	-77	-54	-43	-47	-39	-43	-36	-75	-61	-50	-53	-83	-99	-99	-99	-37	-50

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	64	47	29	33	29	12	-30	-44	-39	-31	-14	3	29	-17	-42	-40	-35	-39	-54	-6	22	49	80	59
55	45	32	22	24	24	21	7	-8	-7	-13	2	20	24	-2	-6	-10	-5	-17	-33	-15	3	16	40	39
50	25	15	11	12	14	27	40	21	17	6	20	25	15	9	28	21	23	1	-14	-36	-27	-33	-8	11
45	-8	-26	-11	-5	2	30	60	36	31	23	26	13	5	10	44	39	38	7	-8	-52	-46	-70	-52	-36

TABLE 63
Corrections Applied to the Lick 28

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	20	8	5	17	28	36	15	-5	40	44	50	42	99	91	39	-4	-28	-9	-21	-25	-70	-46	-13	13
30	19	2	-4	4	21	28	32	21	36	42	40	33	57	58	35	22	-1	29	19	36	-10	-9	12	23
25	11	4	-5	-1	8	19	25	21	13	10	12	4	24	25	24	32	20	51	46	58	43	7	23	11
20	-1	3	2	11	2	24	5	13	3	-18	-10	-5	15	15	19	22	18	12	0	7	35	-11	12	-15
15	-38	-22	-4	20	3	30	-22	-7	-3	-21	-6	20	33	24	31	13	4	-37	-44	-17	37	-6	-3	-51

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
35	13	57	42	96	53	47	20	99	99	74	53	13	29	96	99	70	76	43	19	57	97	58	20	27
30	-13	17	-15	14	-19	-11	-32	22	-19	-29	-9	-27	-17	13	18	8	20	6	-22	-10	13	-7	-21	-10
25	-28	-29	-47	-32	-33	-42	-46	-25	-45	-17	1	-23	-24	-9	-18	-18	-12	-25	-47	-45	-34	-35	-22	-38
20	9	-9	7	24	45	-13	18	6	2	29	8	-15	-2	40	41	21	20	-15	8	19	20	14	20	-1
15	83	77	99	99	92	12	67	55	44	46	0	1	22	97	99	74	72	6	60	78	66	52	49	83

TABLE 64

Corrections Applied to the Turin 10

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
55	-99	-64	-99	-85	-99	-75	-30	-13	66	27	9	-19	-41	-27	39	99	99	99	79	99	99	48	-45	-54
50	-99	-71	-99	-48	-99	-71	-41	-80	-51	-88	-97	-77	-99	-99	-99	-83	-96	-47	-99	-59	-68	-28	-95	-99
45	-99	-82	-92	-19	-81	-65	-43	-96	-74	-99	-99	-90	-99	-99	-99	-99	-99	-89	-99	-99	-99	-66	-99	-99
40	-99	-71	-22	39	-42	-69	-55	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99

TABLE 65

Corrections Applied to the Bord 00-II

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	-36	-16	-97	-75	-97	-99	-94	-71	-42	-31	-55	-99	-99	-99	-99	-74	-70	-31	-62	-99	-64	-90	-99	-75
15	-70	-33	-37	-63	-33	-52	-77	-86	-99	-93	-75	-50	-80	-62	-81	-31	-14	-60	-11	-62	-68	-53	-35	-42
10	-46	-25	-17	-7	-57	-62	-66	-50	-73	-62	-52	-83	-59	-77	-37	-49	-29	-38	-28	-42	-32	-65	-52	-31
5	99	-99	-99	-99	12	-99	-92	-99	-99	79	99	-45	-99	-28	-25	-99	-95	-52	-63	-99	-99	-99	-99	99

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20	23	46	34	25	65	39	46	60	43	4	55	52	35	5	3	-22	67	99	90	-1	-7	-5	39	70
15	57	47	23	45	47	31	27	20	39	26	35	19	42	44	63	85	56	27	29	47	42	38	69	52
10	56	45	45	93	57	36	44	47	61	21	52	69	44	48	35	91	99	48	99	33	-1	46	-14	5
5	99	99	32	-24	14	79	99	99	-71	-99	-37	32	99	99	43	99	60	-85	50	99	99	99	99	99

TABLE 66
Corrections Applied to the Ottw28 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	0	-51	-51	-17	37	41	32	28	27	26	-6	12	12	12	12	11	-90	-7	-1	-1	0	0
85	-6	0	-5	-26	-41	-26	0	24	27	25	20	14	-10	2	5	6	7	6	-42	-21	-9	-2	-2	0
80	-3	-11	-27	-28	-31	-17	-7	-9	-5	-2	-11	-8	-13	-45	-46	-30	2	16	-26	-16	-22	-4	-12	11
75	-3	1	-24	-6	-29	-9	4	21	38	48	26	27	10	-36	-35	-24	24	20	-9	-10	-14	0	-11	15
70	-14	14	33	24	-8	-12	-14	10	34	44	14	34	56	54	39	26	35	25	64	52	62	13	2	-12
65	44	55	86	47	87	31	31	4	22	-3	4	27	70	57	35	29	22	7	-18	8	26	11	5	35
60	21	45	32	44	99	34	26	7	53	81	64	34	41	9	-5	-23	-19	-23	-28	-17	-24	-23	-27	2
55	-24	-46	-72	-37	35	-48	1	6	49	33	36	28	14	-1	-2	-18	30	14	26	7	44	4	17	-43
50	7	-13	-40	-35	-70	-99	-33	-20	39	-47	2	6	0	-6	-16	11	44	25	40	50	99	67	34	-20
45	15	4	5	10	-7	-19	0	-14	64	23	40	26	40	41	19	11	12	-1	20	31	52	31	7	4
40	-8	-21	-13	-11	-5	4	19	-17	8	13	42	37	28	50	35	31	33	4	25	-11	6	2	-5	-18
35	-5	8	-6	-1	3	18	33	29	1	-5	19	38	31	33	52	59	59	37	56	-18	5	8	15	5
30	-12	26	-18	-9	16	39	69	82	49	14	19	-2	57	20	40	36	21	39	55	25	24	72	80	97
25	-74	39	8	4	-28	-5	6	27	4	-37	54	3	61	28	-19	-29	-38	11	21	35	36	43	-20	-14
20	-35	12	43	28	59	13	-32	-42	-18	-21	33	5	6	-4	-8	3	-5	9	-8	-9	-11	17	-14	-39
15	22	10	47	-74	-3	-26	-3	16	33	36	6	-20	4	-5	17	19	41	2	-17	16	-8	-19	-43	-25
10	-1	-40	-16	-44	13	14	5	-3	41	45	-4	-48	3	-14	37	23	36	-5	-11	86	71	4	-21	-55
5	36	-47	-32	15	7	20	-43	-99	-56	-30	-29	-37	-32	-62	-8	-22	-12	-19	4	-11	-5	-51	-7	-72
0	97	-10	-6	-33	-89	-89	-99	0	-99	43	43	27	-22	-59	-20	-25	21	40	25	-6	-38	-63	-7	-31
-5	-99	-99	-99	-99	-99	-99	-99	0	0	97	97	38	-20	-50	-95	-95	-99	76	40	40	-54	-54	-99	-99

TABLE 66 CONTINUED

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	0	27	27	58	99	41	7	-3	-8	-8	-87	12	13	13	13	10	-70	13	18	20	20	20
85	-59	-85	-91	-34	2	20	8	4	6	6	6	-7	-51	24	17	18	-9	2	-47	-19	4	16	20	21
80	1	-25	-38	-25	-5	4	-13	-1	4	1	19	-9	-7	99	31	60	-61	38	-8	-40	-34	2	20	41
75	24	8	16	20	42	37	32	75	28	-8	-2	-1	19	-12	-99	-64	-86	21	17	19	0	25	19	34
70	-47	-43	5	-1	19	6	5	16	16	14	7	2	-21	6	26	41	16	17	-71	-3	-5	30	-5	-30
65	-10	26	48	51	-74	-60	-56	-5	24	18	-8	10	-29	2	16	31	22	0	-68	-6	-13	24	-4	6
60	-14	3	35	48	-47	-78	-63	-22	14	3	-53	4	-1	9	-5	-81	-69	-41	-13	19	-39	-17	-52	26
55	-43	-31	37	-14	31	-97	-21	-8	38	-13	-26	-2	46	28	0	-95	-12	77	99	91	-53	-4	-51	42
50	-79	-26	-33	-71	-39	-99	-20	-35	-11	-56	-2	22	-25	-31	-91	-99	-84	-53	-41	-21	-70	-13	-34	-6
45	-51	17	-3	-19	32	15	-1	-51	-8	18	7	-26	-56	-9	32	-6	1	40	57	48	-12	17	1	-18
40	-36	-11	-38	-58	-18	-31	-50	-15	28	53	30	13	16	42	34	-36	-36	-38	-15	-18	-16	18	16	1
35	-63	-58	-19	-4	-36	10	11	74	-35	-20	-51	-55	-56	-19	-37	-77	22	-23	27	-51	-13	8	28	-22
30	-75	-44	2	16	6	36	35	40	-7	-5	-12	-25	-26	49	41	9	52	-13	1	-44	-1	-3	-66	-99
25	31	3	-2	-46	-4	13	40	2	-7	-30	-27	-5	-3	3	31	-24	-39	-6	-19	-1	18	39	24	-1
20	-9	19	-5	-24	95	90	94	21	-14	-11	-45	3	-5	7	25	12	-16	24	-8	-37	-54	-38	-30	-11
15	-27	29	-69	-33	-18	-34	1	-15	4	18	-5	-37	-89	-46	16	40	15	-1	-7	-38	-55	-65	-53	-12
10	8	-26	-77	-10	-26	-68	-34	-5	-2	9	1	-1	-67	-34	-38	-12	-70	-75	-76	-45	-16	-47	-33	-22
5	-84	-91	-35	49	41	24	33	99	-20	1	-17	52	-3	-13	-4	-32	-83	-96	-14	-26	19	-47	-39	-99
0	-31	-23	-2	12	-37	-37	-67	0	-99	-1	-1	28	-1	-23	20	2	67	-13	28	-55	-5	-55	-21	-92
-5	-40	-40	-98	-99	-99	-99	-99	0	0	89	89	50	13	-16	17	17	99	-99	-99	-99	-99	-99	-8	-40

TABLE 67
Corrections Applied to the Ottw42 50

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	0	99	99	65	-4	-4	15	26	31	29	29	7	7	7	7	7	10	4	1	1	1	1
85	22	27	28	60	96	77	29	18	29	42	40	36	21	15	8	10	-2	9	-7	1	-2	-1	1	1
80	11	13	15	15	7	16	3	12	-11	-23	-19	0	10	44	16	24	-10	15	-14	-8	-15	-11	2	0
75	7	0	-4	-8	-13	-18	-36	-28	-19	-5	-6	2	3	71	64	54	8	-7	-31	-26	-11	-14	1	0
70	42	25	3	-7	0	7	-7	0	27	52	14	14	6	7	0	-6	-10	-28	10	20	32	-14	-1	3
65	24	33	58	24	12	-5	4	9	31	5	0	-21	6	-2	0	-19	-23	-27	-10	5	14	-25	-27	-22
60	-8	16	31	21	0	-27	-12	-22	17	-29	35	-18	2	-11	3	47	34	20	-17	-12	-11	-33	-7	-38
55	0	-11	-8	15	-5	-29	-2	-9	13	-35	4	-8	-16	-65	-98	-34	-8	5	4	-29	5	-3	70	-2
50	7	43	19	13	4	5	-20	4	-52	19	-16	-4	-29	-16	-27	-10	-8	-5	11	40	-4	6	16	10
45	-10	21	3	-7	-23	-12	-40	-48	-99	15	34	55	11	-4	7	33	57	67	68	84	13	31	25	18
40	-27	-25	-13	2	-17	-15	-31	4	-11	20	21	39	42	-3	19	37	63	50	18	14	-15	-10	4	12
35	27	28	2	25	-29	1	-10	24	-5	-6	-26	-19	28	-12	9	2	25	7	2	21	-2	-11	-1	43
30	-31	33	1	44	-44	20	13	21	14	13	32	12	74	20	27	-34	-3	5	29	48	34	43	32	55
25	-29	22	0	25	-23	-4	47	28	22	10	31	48	38	-7	27	-22	-3	-38	-5	18	48	54	37	45
20	56	37	25	-12	-29	-84	15	-4	3	-4	-9	14	5	-15	-6	5	37	10	27	35	14	11	18	45
15	18	-21	-41	-15	14	-16	24	-11	-1	-2	16	19	67	47	9	-29	-35	18	-16	35	-9	-24	-44	-11
10	-1	-40	-38	-1	2	-22	11	21	4	-14	-13	-26	-17	-23	-11	-23	-31	7	-9	78	15	31	-2	8
5	67	4	5	-14	-24	-22	23	99	56	12	-4	-34	-28	-32	25	26	48	-3	-17	-25	-21	18	9	22
0	20	5	4	-27	-25	-31	-22	15	11	-21	-37	-34	-21	-36	6	-24	-21	-19	-27	-18	-37	-41	-50	-46
-5	-4	56	34	21	-23	-31	-55	-28	-17	-45	-40	-6	28	24	18	-41	-9	53	82	76	-9	-88	-87	-48

TABLE 67 CONTINUED

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
90	0	0	0	99	99	99	51	2	-19	-27	-32	-33	-82	22	23	23	23	1	-99	-72	10	38	50	50
85	-17	2	1	53	99	86	23	-17	-30	-32	-37	-48	-67	32	5	11	-54	-38	-99	-99	-51	22	48	47
80	-30	-22	-30	-21	9	57	54	16	42	61	21	-5	-47	97	-42	8	-99	39	-9	-12	13	96	42	37
75	-34	5	-14	27	-5	34	77	54	44	22	13	20	18	-17	-45	-48	-27	-35	-6	46	99	99	34	27
70	-30	35	79	90	-1	-15	4	6	-18	-21	49	44	68	42	52	42	53	-25	50	22	53	-14	-5	-2
65	-5	1	9	23	8	-29	-53	-70	-56	-18	42	-5	30	8	19	28	50	47	71	-57	5	-19	19	34
60	11	-4	-4	9	9	-19	2	4	36	-10	17	-92	-31	-71	-41	-99	-87	-99	-27	-99	-76	-19	3	41
55	-32	-16	-17	35	26	53	46	10	7	-36	17	27	52	-1	22	-92	-28	-99	-99	-99	-22	-1	-35	-4
50	-60	-53	-17	17	-7	24	9	19	-17	5	21	50	-9	-70	-79	-26	25	-35	-12	11	19	27	10	-24
45	-8	2	21	34	66	65	64	28	-2	-33	-19	-55	-18	-54	-18	89	46	72	31	61	40	51	47	21
40	76	99	71	49	87	86	96	-14	21	15	64	34	43	-27	15	20	-16	0	10	45	27	8	28	68
35	37	-2	26	18	57	4	-13	-73	-38	-27	22	7	63	-17	63	-5	-1	-7	13	30	-4	-49	-20	39
30	9	-2	41	38	40	-26	9	-19	-16	-25	-7	-10	45	-9	64	13	26	-55	22	24	55	12	24	19
25	4	18	39	37	85	67	99	30	-40	-11	-46	-22	-37	-93	-39	-36	5	-67	-8	20	83	56	29	13
20	40	42	60	17	60	-17	26	61	52	75	-17	27	43	52	99	44	33	30	7	52	50	28	21	16
15	1	-22	1	-20	47	-29	-23	47	82	0	-44	-20	42	-13	17	-67	-14	0	-21	22	3	-7	-10	-13
10	-30	43	-14	32	63	45	77	88	92	-26	-34	-21	22	30	-34	-51	-7	29	13	48	-5	39	4	35
5	-68	38	-36	25	99	99	99	62	50	36	41	50	66	81	26	27	-8	4	-5	26	16	61	-13	31
0	-13	15	-70	-99	-44	-29	46	7	6	12	44	-33	-16	-70	0	-26	-38	1	24	40	1	19	-28	29
-5	94	99	49	51	-75	-48	-31	44	21	32	86	25	46	-40	40	8	-22	-9	3	43	-15	-8	35	86

TABLE 68
Corrections Applied to the Konl7 25

Right Ascension

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	-40	-99	-99	71	99	99	-99	-99	-99	-95	-47	-61	-99	-21	6	-99	-99	-23	-24	-99	-99	99	81	-64
55	-48	-49	-58	-53	-42	-84	-55	-58	-18	-60	-35	-32	-95	-59	-41	-40	-54	-82	-54	-73	-25	-86	-60	-61
50	-35	-15	-50	-43	-39	-38	-63	-74	-63	-80	-59	-76	-58	-78	-68	-71	-43	-90	-34	-68	-46	-18	-16	-54
45	99	99	-99	20	59	-17	-77	-99	-99	-99	-99	-99	-85	-99	-99	-99	-41	-99	-99	-99	-99	0	-99	35

Declination

dec\ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
60	59	99	99	-76	-93	-53	99	99	99	12	33	-27	-99	-99	-99	99	99	99	-8	17	-99	-99	99	99
55	-5	-32	30	-4	1	28	-68	-45	33	37	6	6	39	30	-72	8	35	35	9	43	14	-42	-13	62
50	49	24	39	31	35	42	68	38	26	14	49	47	67	43	61	99	-15	44	46	32	54	54	19	69
45	46	45	99	0	-99	-99	6	99	36	64	99	22	45	-94	3	99	-17	2	-58	-99	-99	0	99	99

CHAPTER IV
RESULTS

Residuals Between the Two Versions of the NIRS

After I compiled my version of the NIRS, I compared my positions and proper motions to those in the original version compiled by Corbin. I computed position and proper motion residuals in the sense Corbin minus Cole. Figures 1 through 4 give the distributions of these position and proper motion residuals. The one sigma dispersions of these residuals are .02 and .03 arcseconds for right ascension and declination respectively and 0.16 arcseconds per century for both proper motions.

The absolute value of all of the position residuals were less than 0.35 arcseconds with 95 percent of them being less than 0.05 arcseconds. One "pathological" case arose with the proper motions in right ascension, however. AGK3R number 10314 indicated a difference in proper motion in right ascension between the two versions of the NIRS of 166 arcseconds per century. This was rather alarming since the next largest difference was only four arcseconds per century. Referring to the original independent catalogue data, I noted that this proper motion was computed on the basis of two observations, those of the AGK3R and the Buch

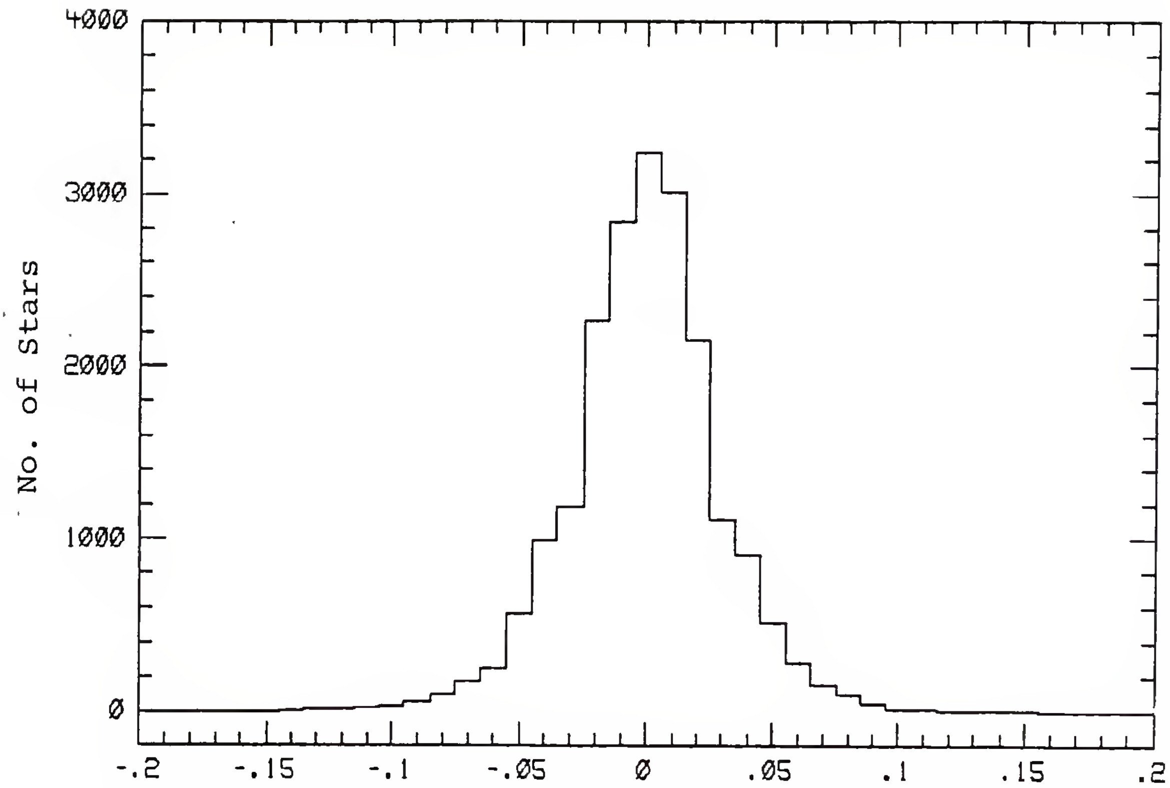

Figure 1: Distribution of Right Ascension Residuals, Corbin minus Cole in arcseconds

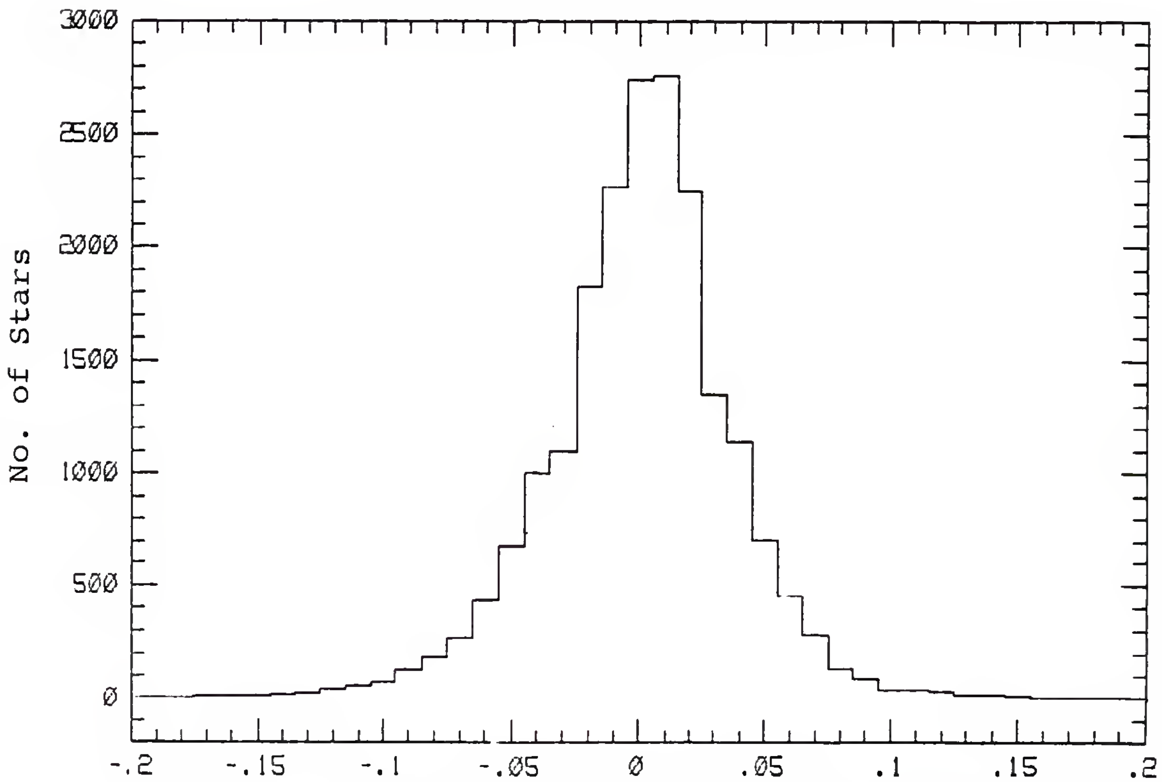

Figure 2: Distribution of Declination Residuals, Corbin minus Cole in arcseconds

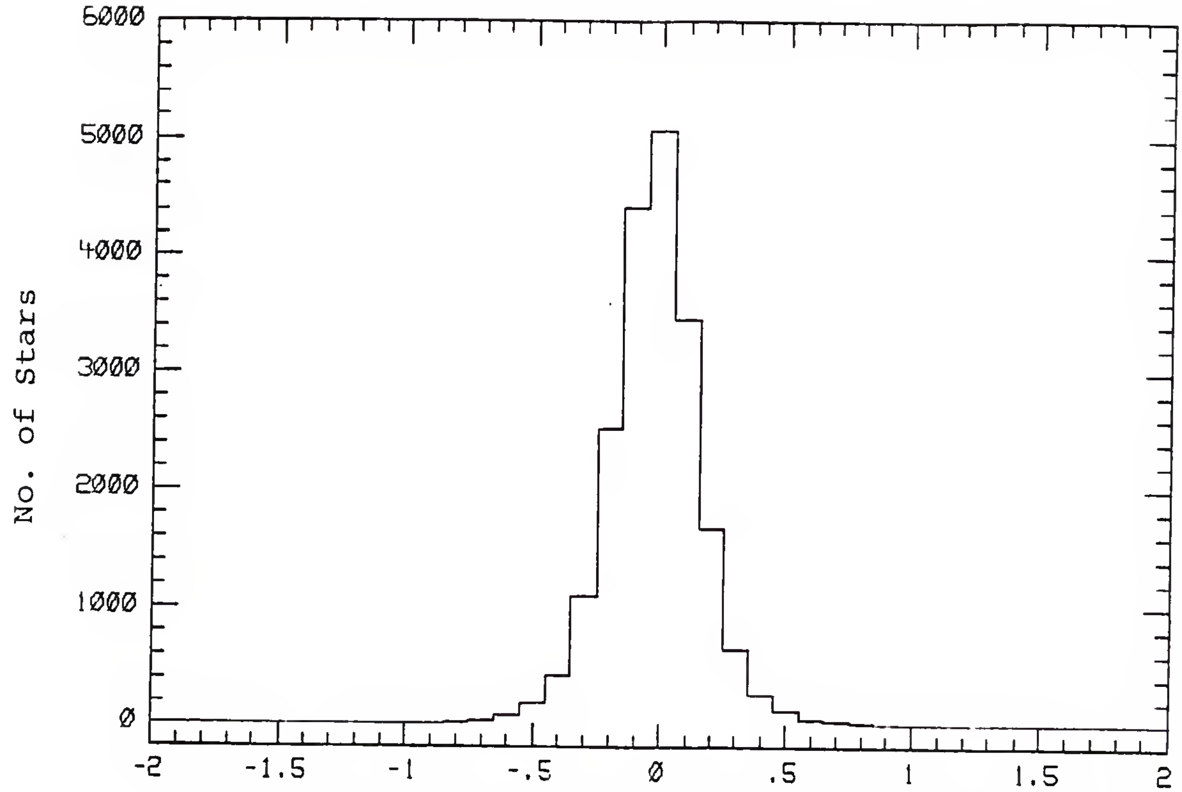

Figure 3: Distribution of Proper Motion in Right Ascension Residuals, Corbin minus Cole in arcseconds per century

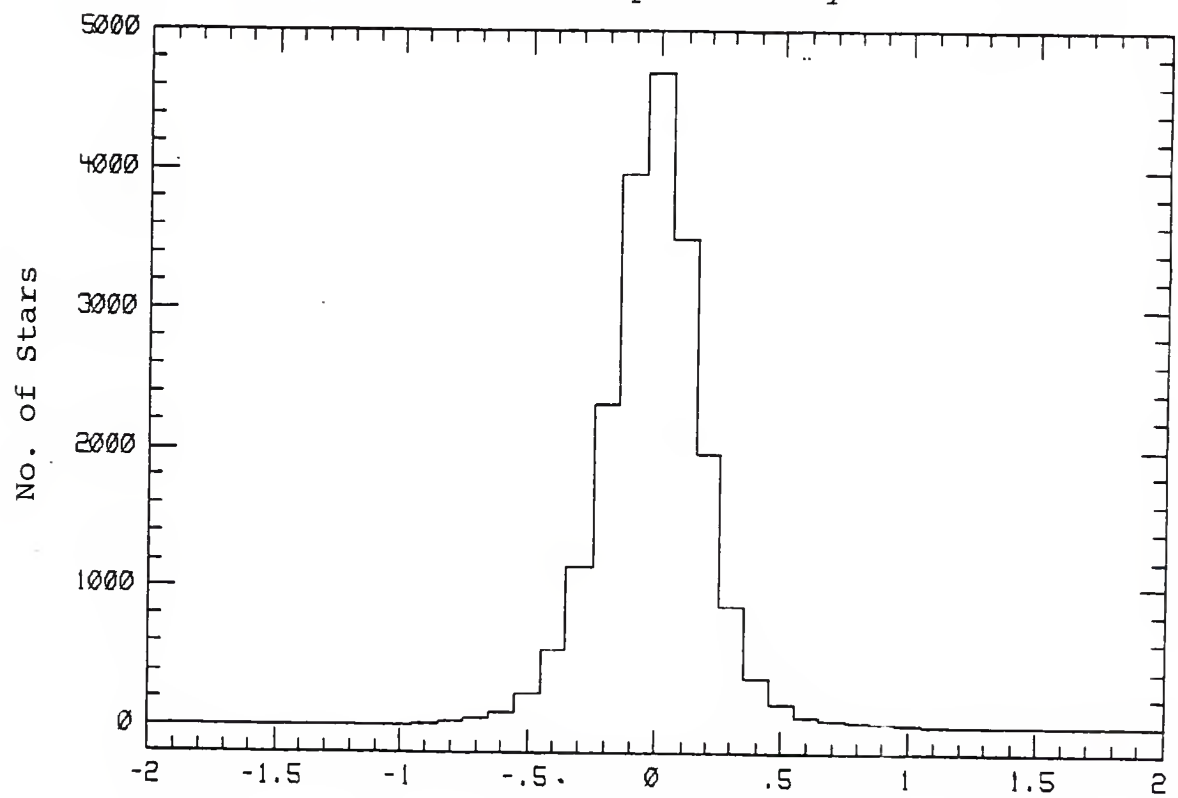

Figure 4: Distribution of Proper Motion in Declination Residuals, Corbin minus Cole in arcseconds per century

50, whose epochs were separated by only 0.028 years! With this separation in epochs a position difference of 0.05 arcseconds between the two ICs would result in a proper motion difference of 178 arcseconds per century. By the criterion that two position proper motions should have epochs seperated by at least 28 years, this proper motion should not have been included in any NIRS catalogue. Thus, for the purposes of comparing the two versions of the NIRS, this proper motion in right ascension was not included.

Tables 69 through 72 give mean values of the residuals in position and proper motion, in the sense Corbin minus Cole as a function of right ascension and declination. These were averaged over blocks one hour of right ascension by five degrees of declination and the units are hundredths of arcseconds. The last column on the right of each table gives mean residuals averaged over zones of declination five degrees wide while the last row for each table gives mean residuals averaged over bands of right ascension one hour wide. The final number on the bottom of the right hand column of each table gives the overall mean of the residuals. The right ascensions as well as the proper motions in right ascention in figure 1 and 3 and table 69 and 71, as with all figures and tables involving right ascension, have been multiplied by the cosine of the declination.

TABLE 69
Mean Right Ascension Residuals, Corbin minus Cole

units of ".01

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
90	-4	-3	0	2	0	-5	0	3	0	-12	0	-21	0	-10	0	-2	0	-5	0	3	6	0	-4	0	-2
85	0	-1	0	1	2	-2	-1	-2	-1	-2	2	3	-2	-4	-4	-3	-5	-7	-6	2	5	4	3	1	0
80	2	3	4	2	-1	-4	1	0	2	1	3	6	-1	0	1	1	1	-1	0	0	0	-2	3	5	0
75	-1	1	4	-1	-3	-5	-1	0	2	2	1	1	-2	0	2	1	-2	0	1	2	-1	-4	1	3	0
70	0	-2	0	-2	-2	-4	-3	-2	0	-2	-1	-4	-1	2	0	0	-1	0	2	-1	-2	-2	-1	0	0
65	4	5	6	2	0	-2	0	-1	-1	-3	0	-1	2	4	0	1	-1	1	5	2	1	0	-1	1	0
60	0	2	1	-4	-2	-1	0	-1	-1	0	1	-4	-3	1	1	2	-1	1	2	1	1	0	-1	-1	0
55	-2	0	0	-1	0	1	1	0	1	2	0	-1	-1	-2	0	2	1	1	0	1	-1	-2	0	0	0
50	-1	-1	-1	0	3	1	-2	-1	0	-1	-1	-1	1	-1	0	-1	0	0	0	-1	3	-1	2	0	0
45	-1	-2	-1	2	0	-2	-2	-2	-4	-2	0	-1	-1	-1	0	-2	-1	-3	-1	-3	0	-1	1	0	0
40	-3	0	1	2	0	3	1	-1	-3	0	2	1	1	0	1	-1	0	-2	-1	-1	1	1	2	-1	0
35	-2	0	1	2	3	4	2	4	2	1	-1	1	1	0	2	3	6	5	2	2	1	2	2	1	0
30	-2	-5	-1	2	1	-1	-2	2	1	1	-1	-1	-1	1	2	1	0	-1	-7	-3	-2	4	0	-1	0
25	-1	-2	1	2	2	1	2	2	0	-1	-1	-1	0	-1	-2	-1	0	-3	-8	-5	-2	2	2	1	0
20	1	0	0	-1	0	1	2	1	0	-1	-1	1	2	3	1	0	0	-2	0	0	0	1	2	3	0
15	0	-1	-2	-3	0	1	1	0	-1	-2	-1	-2	-1	1	0	-2	-3	-2	-1	0	-2	-1	-1	-1	0
10	-1	-1	0	0	1	1	-2	-2	-4	-2	-1	1	1	1	-3	-2	-2	-1	0	2	-1	-1	-4	-2	0
5	3	2	1	0	2	3	0	-1	-2	-3	-2	-2	1	0	-2	-2	0	2	1	-2	-3	-3	-2	1	0
0	2	1	-1	0	3	4	2	2	0	-2	-1	-1	1	-1	-2	-2	1	1	2	0	-1	-2	1	2	0
-5	1	-3	-3	-1	3	2	1	0	0	0	0	-1	-1	-2	0	3	5	2	0	0	1	3	4	2	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0

TABLE 70
Mean Declination Residuals, Corbin minus Cole

units of ".01

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
90	-3	5	6	0	0	9	0	-39	0	3	1	9	0	-9	0	-12	0	-4	0	1	-3	0	13	0	2
85	-9	-3	3	-3	-5	3	-7	-1	-8	1	-2	2	1	-4	-2	-3	-5	-5	-2	5	3	1	4	-5	0
80	10	4	5	3	5	2	-3	-1	-2	-1	-4	-3	-3	-1	2	5	5	5	4	3	0	2	7	6	0
75	10	5	2	-2	0	4	2	2	1	2	2	5	2	0	2	3	2	2	-2	-4	-1	3	0	0	0
70	2	-3	-5	-3	-2	1	-1	0	-2	2	0	2	-1	-3	0	-1	1	0	-1	1	-2	-5	-6	-3	0
65	1	-1	0	2	-1	-3	-4	-1	-6	-10	-9	1	1	-1	0	1	1	1	1	0	0	-6	-2	1	0
60	4	-1	2	3	-1	-2	0	3	-1	-3	-1	1	-3	-5	-1	3	1	0	-1	0	1	-2	3	3	0
55	2	1	1	0	1	-1	0	4	2	-1	-1	-1	-1	-4	-1	3	0	0	-2	0	3	2	5	0	0
50	5	2	1	0	3	-2	-2	-1	2	3	4	0	-3	-2	-2	-1	-3	-3	0	0	3	3	2	3	0
45	1	-1	-1	0	0	-3	-1	-3	0	0	2	4	0	-1	-2	-2	2	0	2	1	1	1	0	1	0
40	-1	-1	0	0	0	0	1	-1	-2	-2	-1	2	-1	-3	-3	-1	1	-2	2	5	2	-1	-2	-2	0
35	2	1	0	-1	0	0	4	5	1	0	-1	1	1	1	0	2	3	0	0	2	1	3	3	3	0
30	0	-4	-6	-2	-1	2	5	2	-1	1	-1	2	0	1	1	0	-4	-5	-3	5	1	2	1	2	0
25	-1	-1	-2	-2	-3	1	2	-2	-2	-3	-3	-1	2	2	1	1	-1	-2	-1	2	2	1	-1	-1	0
20	-1	1	1	0	-2	3	4	2	1	1	2	5	3	2	1	2	1	1	2	0	2	2	2	-1	0
15	1	2	1	0	0	1	1	0	-1	0	-1	1	2	1	1	0	-1	1	3	0	1	1	0	3	0
10	1	4	2	1	-1	-2	0	1	-2	-3	-4	-4	-2	-3	-2	-4	-6	-4	-1	-1	-1	0	1	4	0
5	1	3	1	1	-1	-1	1	2	0	0	-1	-1	-2	0	2	-1	-3	-1	2	1	0	1	-1	2	0
0	-1	3	0	0	2	2	2	0	0	-3	-4	-3	1	3	3	3	2	2	-1	-5	-7	-6	-9	-3	0
-5	2	9	7	5	1	-2	-3	-3	0	-2	0	1	1	0	0	1	-1	0	-6	-8	-2	-3	-8	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 71

Mean Proper Motion in Right Ascension Residuals, Corbin minus Cole

units of ".01 / century

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
90	29	0	-1	22	0	13	0	-3	0	38	21	174	0	49	0	-30	0	37	0	-10	-57	0	-75	0	-12
85	2	4	-13	9	-4	4	5	13	13	3	-15	0	19	21	5	1	16	44	35	4	-29	-31	-35	-9	0
80	1	-6	-21	-2	10	23	-2	2	5	3	-20	-16	4	14	-6	-6	-11	9	2	-5	-14	-8	-28	-24	0
75	30	11	-13	14	21	24	2	2	-11	-21	-14	-19	4	-4	-18	-3	22	16	4	-7	-7	0	-21	-8	1
70	6	13	20	14	-10	-18	-8	-6	-11	-1	-3	7	5	-19	-1	8	9	-1	3	4	-17	-29	-12	5	0
65	-21	-7	9	7	6	-14	-27	-32	-24	-12	-11	-12	-5	-9	7	1	-8	-19	-21	-7	-19	-36	-24	-14	-1
60	-7	-6	6	10	10	-9	-11	-19	5	-7	-7	-4	8	12	19	11	10	-18	-17	-10	-14	-14	-11	-2	0
55	1	-4	-4	-1	16	-17	-5	3	15	-2	0	-7	0	9	10	0	1	-11	-3	-20	-12	9	3	-1	0
50	-15	2	3	6	7	3	8	9	14	-4	-6	-5	-18	-4	-6	-3	0	-32	-2	1	17	5	-1	-10	-1
45	-11	10	-25	-14	-17	-8	-17	-2	2	-3	-19	-6	-15	-6	7	0	9	-9	-14	-6	-8	-21	-16	-18	0
40	-10	-6	-21	-9	-6	13	-3	4	1	12	-5	19	6	9	22	2	-4	-16	-9	-10	-15	-2	9	3	0
35	-19	-19	0	17	-1	6	3	-7	-25	-4	-2	6	6	21	25	-7	-4	-6	0	8	2	17	-8	-11	-1
30	-13	-4	6	-8	-2	16	28	-1	-6	-9	-10	3	3	-5	-10	-11	-12	-25	-24	-16	-11	4	-4	0	-1
25	-6	0	-1	0	-7	0	-4	-9	-3	-3	-4	-2	-3	13	14	-4	-21	-6	5	-2	-12	-3	-16	-10	0
20	-4	-2	4	4	-11	-1	-7	5	-7	-5	1	2	2	19	2	-8	-4	11	15	-2	-5	-5	-11	-8	0
15	-9	-6	-2	-9	-2	18	1	0	-24	-32	-11	5	-1	-6	-13	5	9	3	6	-4	-21	-9	-5	-6	0
10	3	-8	-8	-11	-4	20	-3	-17	-14	-13	-8	-3	-7	-7	-14	-6	4	3	9	14	11	6	1	6	0
5	0	-4	-1	10	-12	9	-2	-8	-2	-4	1	-4	-12	-5	-2	-1	-7	-7	0	4	20	4	-11	-3	0
0	-4	12	15	19	8	7	9	-5	11	3	-8	-2	-7	-5	0	-8	3	0	-17	-21	9	8	-2	-13	0
-5	0	8	2	3	3	-4	-3	-9	-3	-11	2	7	0	1	-6	-17	3	13	14	-21	5	14	20	1	0
	-1	-1	-1	1	-1	0	2	-1	0	0	0	1	-1	0	-1	0	0	-1	-2	0	2	0	-1	-1	0

TABLE 72

Mean Proper Motion in Declination Residuals, Corbin minus Cole

units of ".01 / Century

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
90	-7	24	-4	1	0	66	0	131	0	20	13	17	0	20	0	34	0	-4	0	66	69	0	54	0	9
85	-3	3	4	2	2	46	3	13	11	-11	-26	-28	-46	26	62	37	-4	-12	13	36	31	8	-10	-19	0
80	56	18	9	-36	-43	-3	16	4	-17	-18	-32	-8	-14	13	8	10	1	-16	2	27	6	-35	-31	10	2
75	79	31	9	10	18	19	28	7	-5	6	17	-6	2	4	-36	-10	16	5	-1	23	9	-16	-4	38	4
70	-13	7	0	12	23	22	24	7	-17	-42	-17	-17	8	15	-15	-2	8	-19	-35	-31	-2	30	-5	-16	-1
65	-16	-12	-27	-23	-14	-13	1	-7	0	2	10	-1	4	1	-3	10	7	-13	-15	-10	21	32	16	-11	-1
60	10	13	9	-2	0	-12	6	4	-2	-9	-29	5	12	-18	-25	-6	-3	-30	-14	-16	2	2	5	-4	0
55	17	11	10	13	4	-1	0	-28	-16	4	8	15	10	2	-6	2	1	-11	-19	-13	8	12	23	32	1
50	4	1	-7	-14	0	1	-9	-29	-3	31	14	25	14	6	-7	-9	1	-25	-29	-31	-11	11	10	8	0
45	8	25	12	-12	-1	4	-13	-19	-6	9	-11	-14	0	2	2	9	1	-6	-3	-21	-25	-11	-4	0	0
40	13	16	7	5	9	15	-1	2	-17	-11	-4	9	15	24	26	17	-6	-8	-6	10	3	8	11	18	0
35	-24	-16	-9	0	5	3	-23	-4	-2	5	-7	7	-13	-9	-11	-12	-16	-9	-13	-6	9	1	-8	-4	-1
30	1	14	1	-9	9	34	14	27	9	7	0	4	10	7	-1	-9	8	7	-19	-22	-10	-7	15	11	0
25	1	-3	-8	-5	-2	2	-3	-2	3	4	3	-4	0	0	2	-2	-3	-4	-23	-20	-20	-22	9	3	0
20	4	-5	-10	-10	1	-10	-15	-11	-9	12	15	-1	-5	-1	-3	-7	-1	-1	-11	-13	-7	-13	-1	12	0
15	20	19	10	10	4	-2	7	-3	-5	-2	-6	-4	1	19	23	18	11	-4	-6	7	21	19	19	10	1
10	9	10	2	5	-12	-13	-21	-15	-18	-25	-16	-16	-7	1	7	-1	7	7	-1	-6	-17	0	-5	-12	0
5	1	5	-12	-14	-5	16	-3	8	-6	4	6	-7	-3	-10	-13	-2	-8	-7	3	-13	2	3	3	0	0
0	5	1	-10	-22	-17	-2	-3	6	-6	7	16	7	-14	-7	4	17	-7	-20	-18	-21	-4	-5	-3	-7	0
-5	-12	-27	-12	-40	-16	-10	-8	-5	-7	-13	-17	-27	-27	-37	-34	-6	2	-6	-24	-31	-36	-5	-1	-20	0
	2	-1	1	0	0	0	1	0	0	0	0	1	0	0	2	0	0	-1	-1	-1	0	0	1	0	0

Overall, the systematic differences between the two versions of the NIRS are not significant in the sense that these differences are not larger than the uncertainties associated with each catalogue. That is, the dispersions of the residuals are smaller than the mean rms errors of the associated quantities. But there are significant differences when one considers the precision and accuracy of the positions and proper motions of the two catalogues.

Internal Errors

The qualitative concept of the precision of a parameter is generally associated with the variance of that parameter. The rms error is the accepted least squares estimate of the square root of the variance of a parmeter. The rms errors for the positions and proper motions of a star are given by the square roots of the quantities in equation (21) of the previous chapter. In my compilation of the NIRS, 17433 stars had three or more independent right ascention positions and 17467 stars had three or more independent declination positions, enabling rms errors to be calculated for these positions and proper motions. For comparison, Corbin had 17682 stars with three or more right ascension and/or declination observations. Table 73 gives the mean of my rms errors as compared to those of Corbin. The uncertainties of these means are .00035 and .00037 arcseconds for right ascension and declination, respectively

and .0022 and .0023 arcseconds per century for proper motion in right ascension and declination, respectively. The reduction of mean rms errors is shown to be between 5 and 7 percent.

TABLE 73

Mean RMS errors

	Right Ascension "	Declination "	RA Proper Motion "/century	Dec Proper Motion "/century
Corbin NIRS	0.075	0.087	0.45	0.46
Cole NIRS	0.072	0.082	0.42	0.44

The distributions of these rms errors are given, for both versions of the NIRS, in figures 5 through 8.

It is well known (cf. Firneis and Firneis 1975) that the formal, internal errors of a process of data reduction are very dependent on the model, the assumptions of that model and the method of solution used. Thus one typically encounters discrepancies between the internal and external errors of various derived sets of statistical parameters. Consider for example the decades-long controversy over the value of the Hubble constant. Two sets of investigators using different methods have arrived at two estimates for

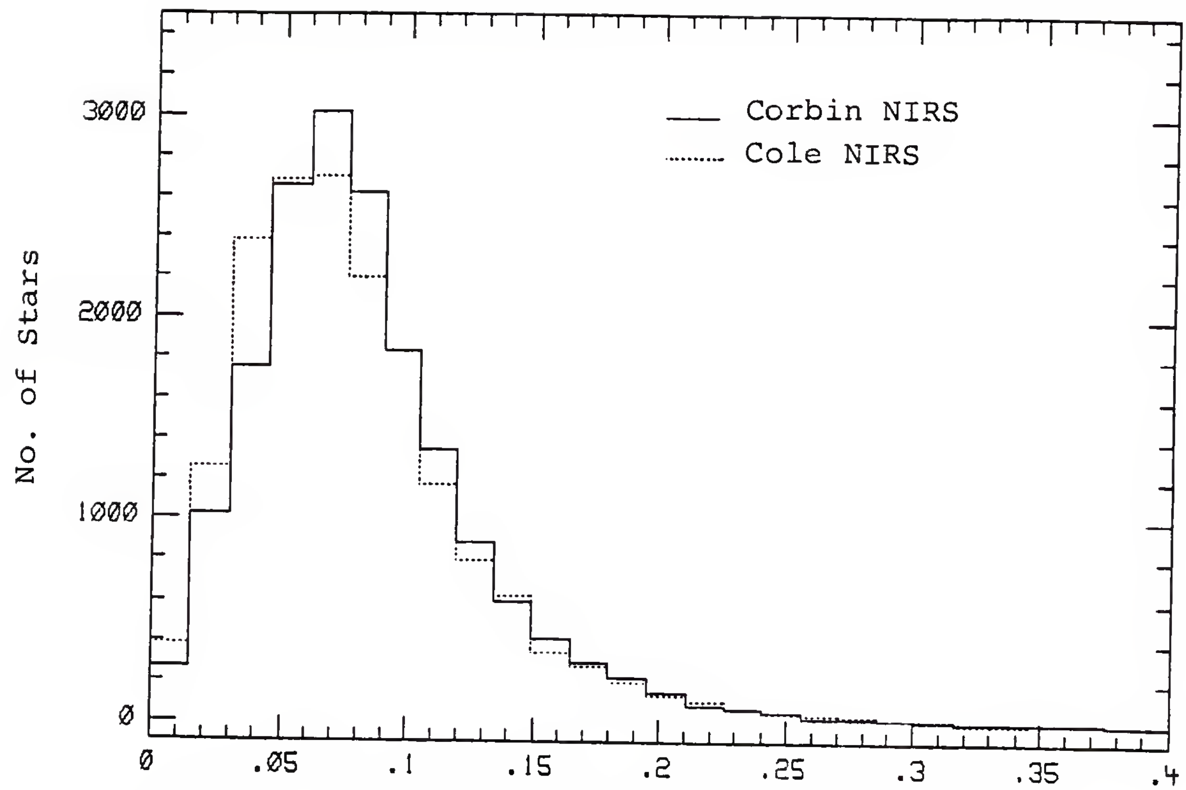

Figure 5: Distribution of Right Ascension RMS Errors in arcseconds

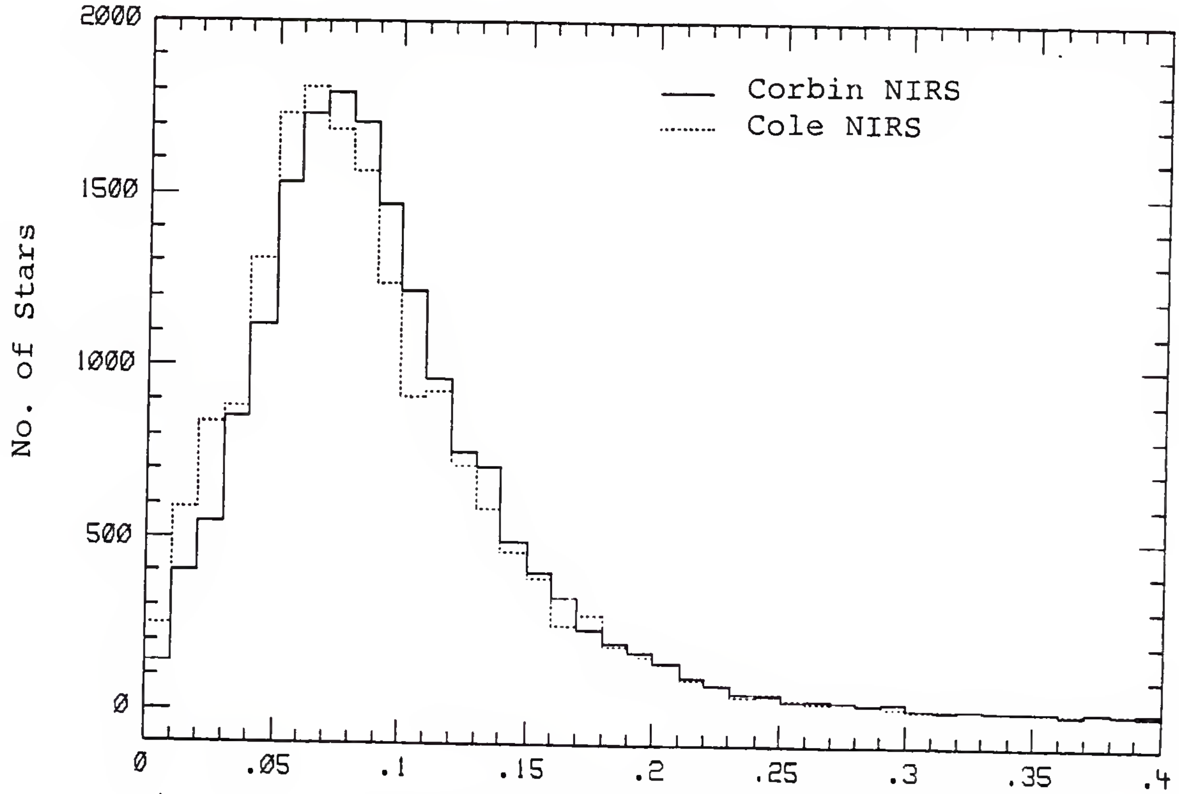

Figure 6: Distribution of Declination RMS Errors in arcseconds

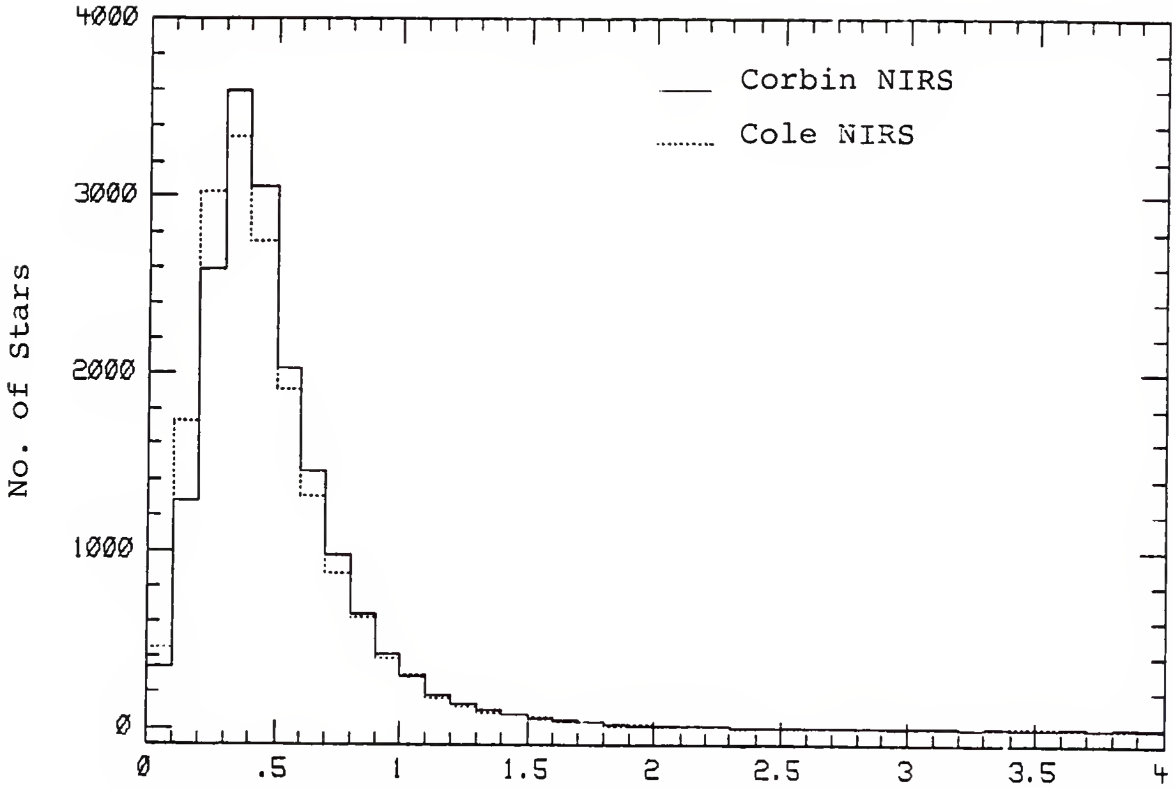

Figure 7: Distribution of Proper Motion in Right Ascension RMS Errors in arcseconds per century

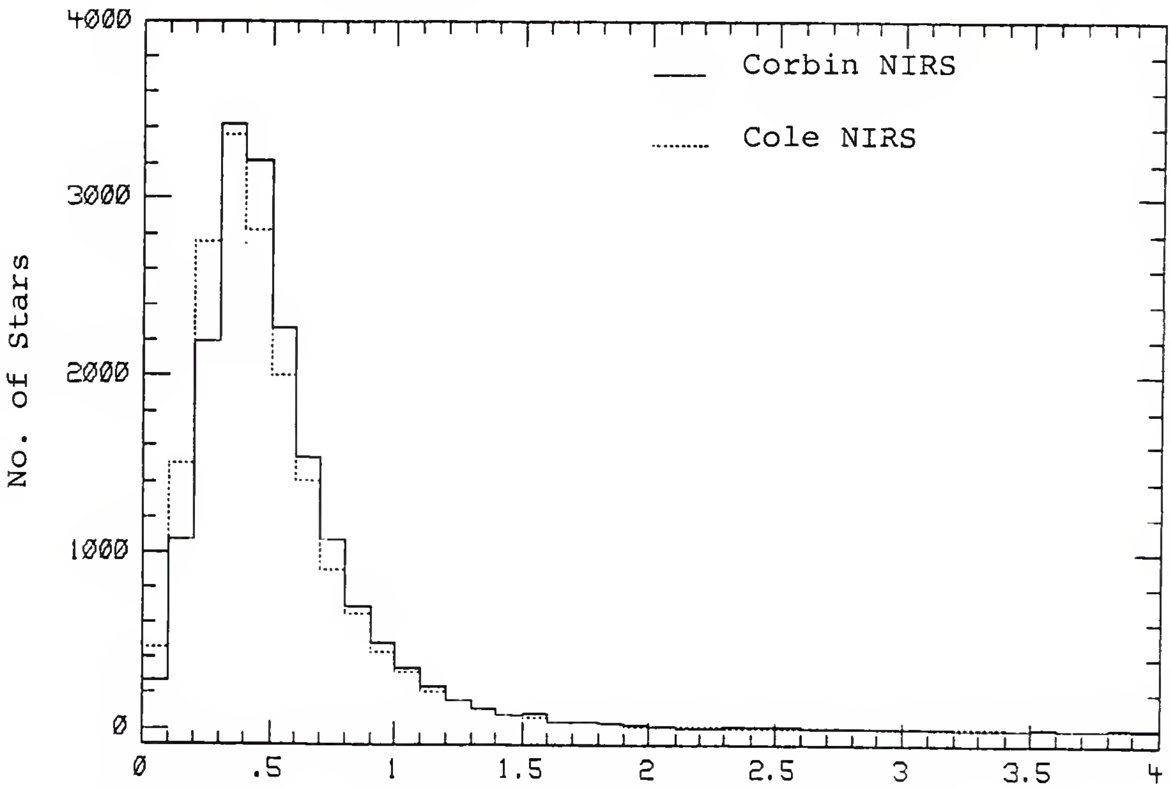

Figure 8: Distribution of Proper Motion in Declination RMS Errors in arcseconds per century

this parameter, but the difference in their estimates is almost an order of magnitude larger than the rms error of either estimate.

But when one compares two investigations which use the same model, the same assumptions concerning that model and the same method of obtaining estimates, the rms errors become a valid basis for that comparison. The NIRS which I have compiled does have rms errors which are significantly smaller than those of Corbin.

Perth 70 Residuals

The real test of my research comes in the form of predicting future observations. The *Perth 70: A Catalogue of Positions of 24900 Stars* (Perth 70) (Høg and von der Heide 1976) is a catalogue with a mean epoch of 1970, 26 years later than the mean epoch of the NIRS. I was able to match 3324 stars of the Perth 70 with the NIRS. I then predicted the Perth 70 positions and computed residuals with the two version of the NIRS. It should be noted that the portion of the Perth 70 which I was able to match has a density of about one star per square degree from -5 degrees to +5 degrees, but only about one star per fifteen squares degrees north of +5 degrees.

Table 74 gives the one sigma dispersion of the position residuals between the Perth 70 and the two versions of the NIRS.

TABLE 74

Position Residuals, Perth 70 minus NIRS

	Mean residuals		Dispersion	
	RA	DEC	RA	DEC
Corbin NIRS	".057	".084	".215	".300
Cole NIRS	".058	".064	".211	".302
Significance level of difference	43%	0.3%	14%	35%
First iteration of 6317 stars	".045	".048	".196	".304

Under the assumption that the residuals are independent and normally distributed random variables, certain conclusions can be drawn. The differences of the mean residuals in each coordinate, divided by the square root of the sum of their estimated variances, form t statistics with which the significance of these differences can be determined. The decrease I have achieved in the mean declination residual is quite significant while the increase in right ascension residual is not.

At this point it might be asked if these mean residuals are due to the system of the NIRS or that of the Perth 70. An indication of how much of the mean residual is due to each of the systems can be found using the first iteration of my NIRS which included only those ICs which could be directly compared to the FK4. The first iteration catalogue

of 6317 stars was compared to the Perth 70 and it is seen that my mean declination residuals are closer than Corbin's to this first iteration system which more accurately represents the system of the FK4.

Another test of significance can be preformed if it is also assumed that the residuals have a zero mean. In this case, the ratios of the squares of the dispersions in each coordinate form F statistics. While the increase in dispersion of the declination residuals is not significant at the 35 percent level, it is not quite as clear that the decrease in dispersion of the right ascension residuals is significant at the 14 percent level.

The distribution of position residuals between the Perth 70 and the two versions of the NIRS are given in figures 9 and 10. The most apparent feature of these figures is the reduction of mean declination residuals which I have achieved.

Mean position residuals between between the Perth 70 and the two versions of the NIRS as a function of right ascension and declination are given in tables 75 and 76. These were averaged over blocks one hour of right ascension by five degrees of declination and the units are hundredths of arcseconds. The last column on the right of each table gives mean residuals averaged over zones of declination five degrees wide while the last row for each table gives mean residuals averaged over bands of right ascension one hour

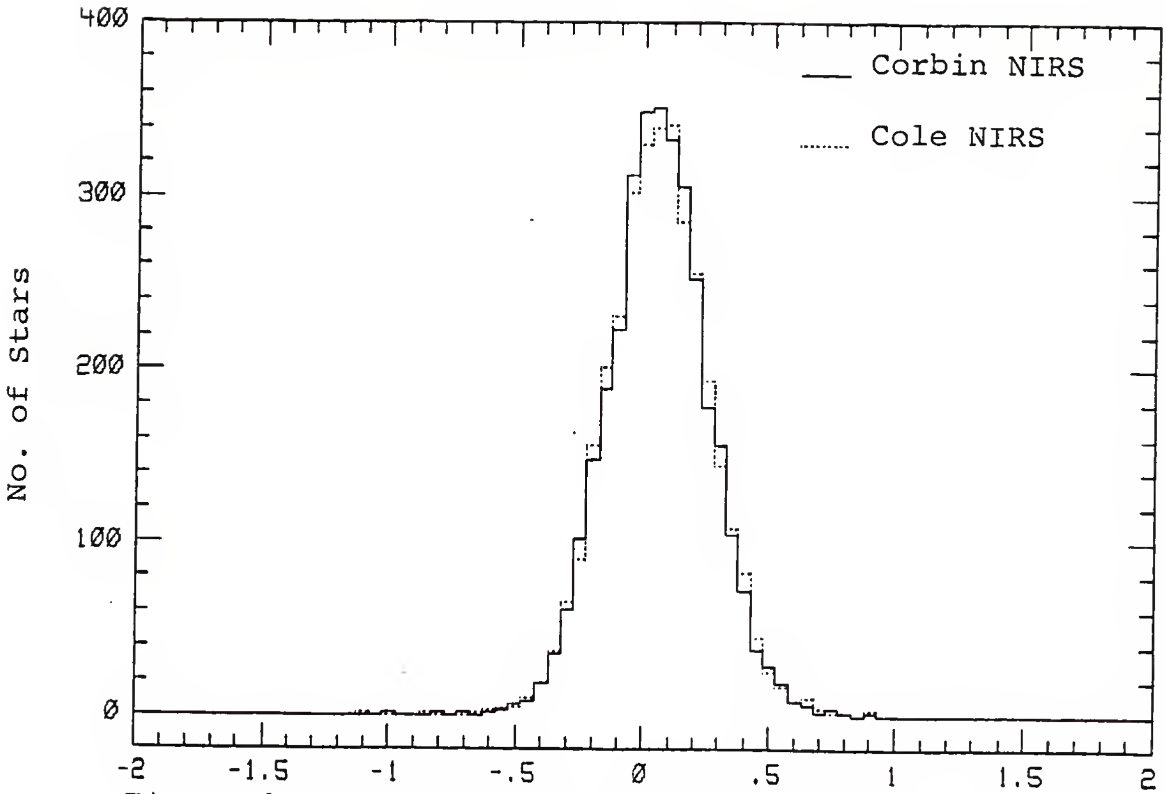

Figure 9: Distribution of Right Ascension Residuals, Perth 70 minus NIRS in arcseconds

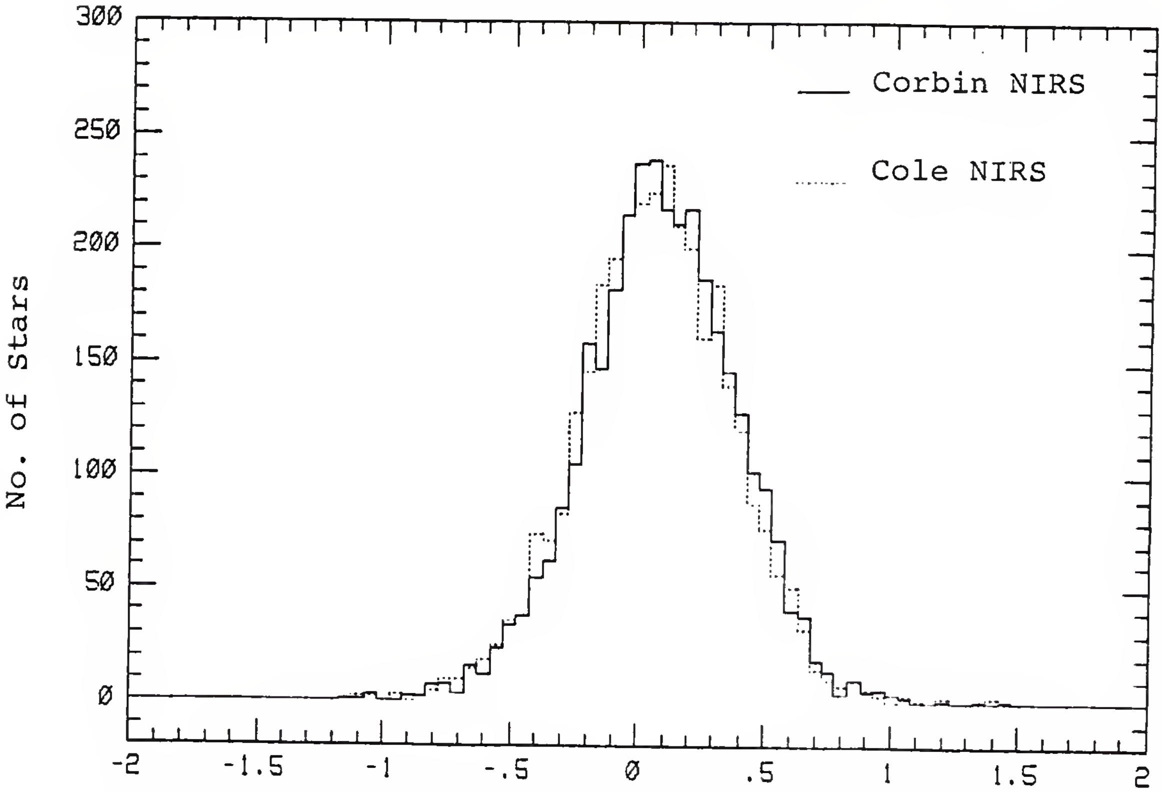

Figure 10: Distribution of Declination Residuals, Perth 70 minus NIRS in arcseconds

wide. The final number on the bottom of the right hand column of each table gives the overall mean of the residuals. When examining these tables it must be remembered that the blocks north of +5 degrees have at most two or three stars and often none. Therefore these means north of +5 degrees are often based on one or two positions.

TABLE 75

Mean Right Ascension Residuals, Perth 70 minus NIRS

Perth 70 minus Corbin, units of ".01

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
35	0	-3	0	0	0	-6	-21	0	14	3	0	0	0	-11	0	-34	-38	0	0	-7	0	0	0	0	-12
30	0	0	0	-8	-7	0	0	4	15	5	-1	-6	-11	15	-6	44	4	0	0	0	0	-32	0	0	-2
25	-10	2	3	-4	-44	13	-12	-14	-1	0	0	-4	-2	0	42	-32	0	0	0	-1	0	-38	0	0	-9
20	0	-17	0	11	0	-4	0	0	-19	-9	0	-11	30	-22	-5	-30	-28	14	0	-31	12	6	0	0	-5
15	-16	-24	0	37	20	0	-21	-2	14	-1	3	0	0	0	-11	0	13	-1	0	2	-21	5	4	0	-1
10	-21	1	26	0	0	3	0	-8	0	0	8	1	9	-8	0	0	8	-20	0	13	18	11	-4	-26	1
5	-1	0	9	8	12	5	5	2	11	6	6	11	-3	0	-5	0	-3	2	-2	4	12	0	6	1	4
0	-1	3	5	11	5	8	3	12	10	8	16	6	8	-1	3	4	0	8	2	5	7	4	2	2	5
-5	1	5	5	9	14	13	10	15	15	24	22	14	12	13	8	10	-1	13	8	14	5	1	2	-2	10
	-1	2	6	9	8	8	4	9	12	11	14	8	6	3	2	4	-1	7	2	6	8	2	3	0	6

Perth 70 minus Cole, units of ".01

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
35	0	-11	0	0	0	-6	-20	0	5	11	0	0	0	-18	0	-37	-37	0	0	-8	0	0	0	0	-14
30	0	0	3	-7	-3	0	0	5	10	2	-7	-1	-6	18	-4	33	-14	0	0	0	0	-34	0	0	-3
25	-4	-3	5	-4	-48	12	-16	-13	-5	0	0	-9	9	0	26	-35	0	0	0	-2	0	-44	0	0	-10
20	0	-17	0	11	0	2	0	0	-20	-13	-1	-9	32	-23	-9	-31	-20	11	0	-34	15	2	0	0	-5
15	-20	-21	-3	30	14	0	-21	4	10	-4	-3	0	0	0	-9	0	11	3	0	5	-22	2	-1	0	-3
10	-24	2	24	0	0	6	0	-14	0	0	8	4	16	-10	0	0	8	-21	1	21	24	14	-9	-25	2
5	1	1	11	12	14	10	6	1	10	3	4	6	-5	-2	-8	-3	-4	1	0	1	14	-2	3	1	3
0	-1	5	8	15	10	14	8	12	12	6	13	3	7	-4	1	0	1	9	-1	-1	8	6	3	1	6
-5	2	4	3	9	18	14	11	13	13	22	22	14	11	10	8	10	5	18	10	10	7	7	10	-1	11
	0	3	8	12	12	13	7	8	11	9	12	6	5	0	0	1	0	9	2	2	9	2	4	0	6

TABLE 76
Mean Declination Residuals, Perth 70 minus NIRS

Perth 70 minus Corbin, units of ".01

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
35	0	-11	0	0	0	-11	7	0	49	-2	0	0	0	18	0	-30	14	0	0	-20	0	0	0	0	2
30	0	0	2	-38	-5	0	0	33	-38	48	11	-24	0	15	-17	-13	0	0	0	0	0	14	0	0	-2
25	-21	-53	-10	14	-21	-67	-9	4	17	0	0	-25	7	0	-4	-51	0	0	0	-46	0	-8	0	0	-19
20	0	-99	0	-6	0	-12	0	0	15	-15	23	24	0	22	47	-16	9	-49	0	-18	18	22	0	0	3
15	44	18	36	42	22	0	36	-3	-3	77	68	0	0	0	30	0	-16	59	0	38	-39	42	-32	0	28
10	-19	56	-27	0	0	-46	0	12	0	0	-16	-6	13	14	0	0	9	-5	-34	-23	-35	15	38	-18	-5
5	-12	-8	-1	-3	-10	9	2	2	7	2	13	19	16	8	6	6	5	-4	17	7	2	-6	-12	-13	2
0	14	19	21	12	13	19	15	11	9	18	20	12	8	9	1	-1	7	5	7	4	11	5	9	11	11
-5	13	24	8	-8	5	16	19	-8	22	13	22	14	12	16	7	13	13	9	6	17	12	-1	8	11	11
	6	11	12	2	5	14	13	5	12	13	19	13	11	11	4	3	7	3	9	7	8	1	3	4	8

Perth 70 minus Cole, units of .01

dec/ra	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
35	0	-11	0	0	0	-15	18	0	48	7	0	0	0	27	0	-42	8	0	0	-18	0	0	0	0	4
30	0	0	-11	-33	16	0	0	34	-40	52	15	-11	-16	14	-18	-16	-7	0	0	0	0	21	0	0	0
25	-20	-58	-15	11	-29	-71	-15	-2	25	0	0	-14	13	0	7	-47	0	0	0	-61	0	-11	0	0	-20
20	0	-99	0	-8	0	-6	0	0	21	-9	33	26	-2	18	59	-15	5	-48	0	-15	14	20	0	0	5
15	47	27	31	42	21	0	39	-1	-11	78	73	0	0	0	35	0	-16	65	0	46	-38	48	-22	0	31
10	-12	63	-30	0	0	-52	0	9	0	0	-20	-13	9	12	0	0	12	-5	-41	-26	-38	15	34	-16	-7
5	-11	-4	-5	-7	-13	14	2	7	6	3	15	18	14	5	4	4	0	-7	18	4	2	-5	-12	-12	2
0	13	22	19	7	10	20	17	12	8	17	21	11	6	10	6	6	6	1	0	-6	3	-2	-1	7	9
-5	12	28	11	-10	2	12	15	-12	21	8	18	9	5	7	-1	13	12	6	-7	2	0	-7	0	6	7
	6	15	10	-2	3	15	13	6	11	12	19	11	8	8	4	7	5	0	3	-2	2	-3	-4	1	6

CHAPTER V
CONCLUSIONS

In investigating the traditional procedures used in the compilation of star catalogues, it has been seen that the procedures which were used in the past result in very good star catalogues. But it has also been shown that the tabular method does have its shortcomings. The foremost of these are that not all available model constraints are used in estimating the model parameters and that the parameter estimates are biased.

When I first started researching the methods used in catalogue compilation, I saw what I thought to be oversights in the data reduction procedures. Now that I have worked with these large quantites of data and their myriad idiosyncrasies, I have come to appreciate the difficulties and compromises involved. What I have referred to as subjectiveness and craftsmanship is actually a long process of trial and error. This tedious work of examining results and subtly modifying procedures produces a catalogue which I have slightly improved upon with my analytical approach to catalogue compilation. I have not examined my results at each stage of the reduction process and modified my procedures accordingly. Rather, I have started with a

clear-cut procedure and seen it through without any "mid-course corrections." What I have shown is that my "production line" method is slightly superior to the "hand crafted" results of the past. With the use of a simultaneous reduction, one can not only have the a catalogue which is better than traditional catalogues, but also the principles and underlying assumptions of the data reduction process are clearly stated.

The catalogue which I have compiled, like most astrometric data, is generally most useful in machine readable form. Therefore, this catalogue is available from the author on magnetic tape. It must also be noted that the original version of the NIRS has been available to and has been used by the the astrometric community for several years. If one wishes to maintain consistency in astrometric research, the original version of the NIRS should be considered for use.

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BIOGRAPHICAL SKETCH

I was born in Columbus, Ohio, on September 9th, 1954, to Lyman and Stella Cole. I was their fourth and last child having three older sisters. When I was three, my family moved to rural Pensylvania and, when I was five, we moved to Rockford, Illinois. I attended St. Peter's Roman Catholic grade school and graduated from Rockford West high school in 1972.

I began my college education at the University of Illinois where I was enrolled in a professional pilot/aircraft maintenance curriculum. I transfered to the College of Engineering and earned a Bachelor of Science degree in aeronautical and astronautical engineering in 1978.

I next moved to West Palm Beach, Florida, were I was employed as a test engineer for Pratt & Whitney Aircraft. While working for Pratt & Whitney, I was responsible for full scale engine tests of the TF30, the engine used in F-14 and F-111 aircraft.

I entered graduate school at the University of Florida in 1980 and earned a Master of Science degree in 1983. I had various outside activities before becoming a graduate student and I may resume my interest in scuba diving, motorcycle racing or skydiving after I graduate.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Heinrich Eichhorn, Chairman
Professor of Astronomy

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Howard L. Cohen
Associate Professor of Astronomy

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Frank Martin
Professor of Statistics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

John P. Oliver
Associate Professor of Astronomy

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Haywood C. Smith Jr.

Haywood Smith
Associate Professor of Astronomy

This dissertation was submitted to the Graduate Faculty of the Department of Astronomy in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1986

Dean, Graduate School